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A paper concerned with the granting of a bounty by the Icelandic Nematode Committee

S. Helgadottir, A. Petersen, and S. Bergmann

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Aevar Petersen
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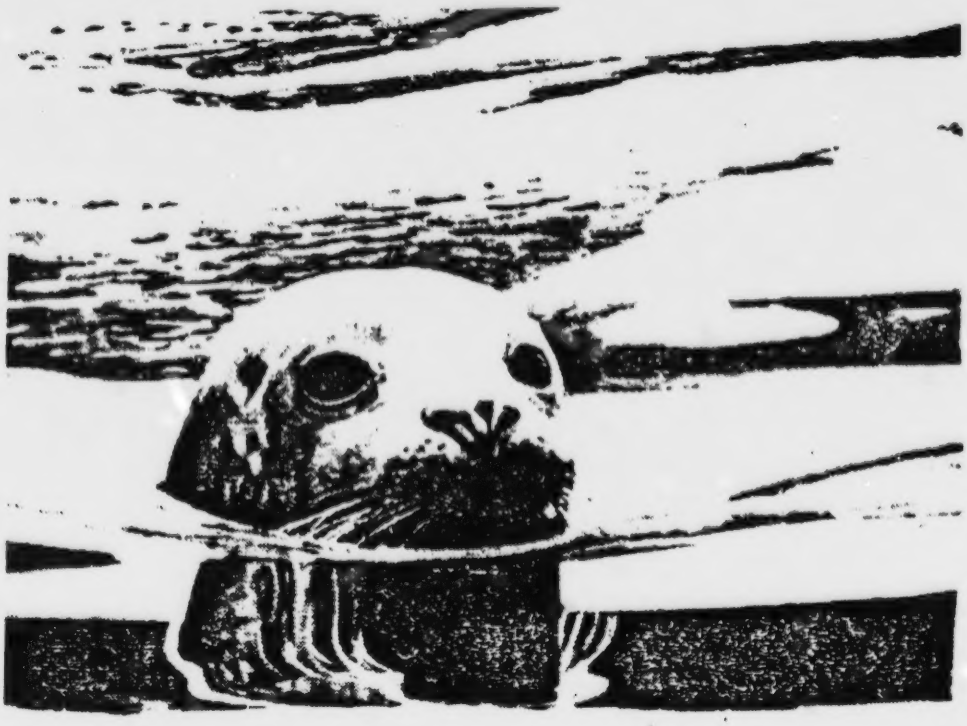
SEALS AND NEMATODES

Harbor seal (Phoca vitulina)



Picture no 1 Drawing by Hubert Pepper

Sigrun Helgadottir Stefan Bergmann
Aevar Petersen

SEALS AND NEMATODES

A paper concerned with the granting
of a bounty by the Icelandic Nematode Committee.

LANDVERND:
THE ICELANDIC SOCIETY FOR NATURE CONSERVATION

Grey seal (Halichoerus grypus)

Picture 2 Photo by Bjorn Rúrikson.

SEALS AND
NEMATODES

1985

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1.0 Introduction

This paper was written because of concerns over the Committee's granting of a bounty for the killing of seals. The committee aims to decrease the seal population for the purpose of fighting nematode infection in harvested fish species.

An article written in Morgunbladid (a daily newspaper in Iceland; comment from translator) on March 18 1982 included information on the Nematode Committee's ideas concerning the bounty on seals. The name of the article is: "THE INCREASE IN THE SEAL POPULATION AROUND ICELAND HAS CAUSED INCREASED WORM PROBLEMS FOR THE FISHING INDUSTRY". One suggestion for decreasing the number of nematodes in fish was to encourage the hunting of seals by granting a bounty for each seal killed (p. 18). The article discussed the work and ideas of the Nematode Committee. Two weeks later the representatives of the Nematode Committee received a letter stating:

> Parties within the Icelandic fishing industry have decided that in order to encourage seal huntings around the country they will pay a bounty for each seal killed. The following bounty will be granted: For each mature grey seal 700 kr; mature harbor seal 500 kr; grey seal pup 250 kr; and harbor seal pup 100 kr.

The representatives were asked to inform hunters in each area of the existence of the bounty.

Around two months elapsed until the public was informed about what was taking place along the country's coasts. Many were shocked when they heard the news.

In the summer of 1982 the media provided a number of reports on seal killings, and articles and announcements appeared on the new seal hunt. A number of individuals, organizations for the protection of nature, and other associations expressed their opinion. The Nematode Committee promptly replied, especially in newspaper interviews, radio and on television, to accusations.

The demand that the authorities get involved in the matter was ignored. For a while the government would not even recognise that it was responsible for first, the formation, and later, the actions of the committee. The lack of any action from official authorities led to the decision by the board of the The Icelandic Society for Nature Conservation (Landvernd) that three biologists should research all material on seals, seal hunting, nematodes in fish, along with the reasons for the formation and actions of the Nematode Committee. The biologists were also to examine the committee's arguments concerning the necessity of decreasing the seal population around Iceland.

The result has been this paper. It attempts to supply an overview of the biology of seals, the history of seal hunting, and its effect on the seal population around Iceland. Nematode infection of fish is discussed and the Nematode Committee's operations are examined. A variety of sources are used, especially Icelandic publications and research reports, while

considerable non-Icelandic material is also examined. The reports of the Nematode Committee have not been published and only exist in mimeograph form. For the purpose of avoiding copyright violations, references to these reports are cited in the same manner as those from published sources.

2.0 General information on seals and nematodes

2.1 The biology of seals

Seals are sea mammals that developed from land mammals around 25 million years ago. Their adaptation to the sea has fascinated many; their habits are thought to be interesting.

Two seal species live and breed around Iceland; the harbor seal (Phoca vitulina) (picture no 1); and the grey seal (Halichoerus grypus) (picture no 2). Migratory seals also travel to Iceland. They are the arctic seal species ringed seal, harp seal, bearded seal, hooded seal, as well as the walrus.# The four last named species have become less common around Iceland. It is highly likely that the ringed seal used to breed here, while no information exists on other species having done so. The walrus probably bred in Iceland centuries ago.

The home of the harbor seal is the northern parts of the Atlantic and the Pacific, along with the warmer parts of the arctic. The grey seal, a species that usually stays further south, lives in the northern parts of the North Atlantic, but usually does not move into the Arctic. The harbor seal exists around Iceland in considerably larger numbers than the grey seal. The harbor seal is most frequently found around the south

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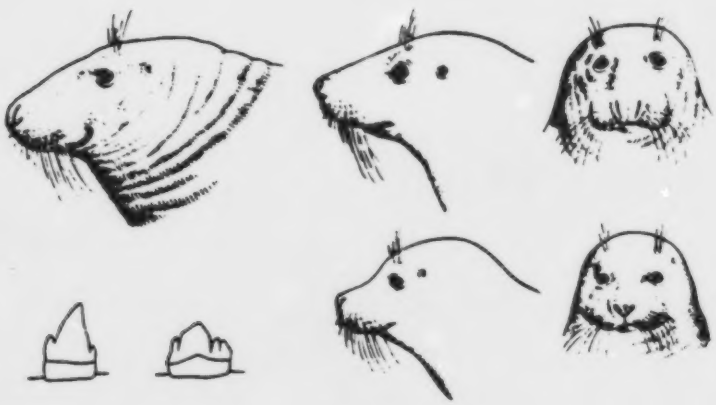
#The scientific names of the species mentioned in this paper are the following: harbor seal Phoca vitulina, grey seal Halichoerus grypus, ringed seal Pusa hispida, harp seal Pagophilus groenlandicus, bearded seal Erignathus barbatus, hooded seal Cystophora cristata, along with the walrus Odobenus rosmarus.

coast, in Faxafloi Bay, in Breidafjordur Bay and Húnaflói Bay. It usually keeps to the inner parts of the fjords, along river mouths, along beaches, and even moves up into rivers. The grey seal usually breeds along the southeastern coast, along the northern part of Faxafloi Bay, in Breidafjordur Bay, the northern parts of the areas Strandir and Skagi. It has spread along the north part of the island in the last few decades. The grey seal lives on rocks off the coast, on peninsulas, and isolated beaches. The grey seal is larger and fatter than the harbor seal. Unlike the head of the harbor seal, the head of the grey seal is large but small at the front (see picture 3.)



Picture 3. A comparison of the head shape of grey seal and harbor seal (from "The Handbook of British Mammals").

The harbor seal gives birth in the spring, in the period May-June. The female seals reach puberty at three to four years of age, while the male seals reach puberty at the age of five to six. The pup is soon able to go into the sea while the female seal looks after it and breastfeeds it for a few weeks. Following this time period, the pup loses its woolly coat and stays for the most part ashore for around a month. The mating season is in the fall, at which time impressive love games take place in the sea, and mating takes place. The gestation period lasts for 9 months, but the development of the uterus stops for a certain period of this time. Some believe that the male and female form close ties during the mating season, and even longer.

On the other hand the grey seal gives birth in the fall, mainly in September-October, in some cases not until February. Although disagreement exists on the matter, it is believed that both sexes reach puberty around age four to five. The pups stay ashore considerably longer than the harbor seal pups or around three weeks, while the female feeds them every 6 hours. The mother appears to be able to identify her pup by its smell and sound. The male seals choose the breeding area, they defend a territory and keep other male seals away. They frequently defend 2-7 females, in some instances many more, and have sexual intercourse with them ashore or in the sea. Seals usually only have one offspring at a time.

This section was written using the following sources: Bjarni Saemundsson (1932), Erlingur Hauksson (1980b), Sólmundur T. Einarsson (1978), Hewer (1974).

2.2 Seal hunting

Considerable information exists on seal hunting and the use Icelanders made of seals in past centuries. In his book "The Icelanders and the Sea I" (1980) Lúdvik Kristjánsson provides an interesting and coherent picture of the relationship the Icelander had with seals, and the role seals played in the nation's customs and culture. Lúdvik Kristjánsson deals with places named after seals, where seals were hunted, hunting methods, the use people made of seals and the seal in folklore and games. Bjorn Gudmundsson (1944) also gathered considerable information on seal hunting past and present.

The oldest information on seal hunting is to be found in Grágás (an ancient Icelandic book of law). In the period 1200-1600 A.D. the role of seal hunting can be examined by looking at the seal hunting that was available as a right to certain churches and and monasteries, seal hunting rights held by farms, the renting of seal hunting permits, and seal hunting fees. In the famous registration of farms by Arni Magnússon and Páll Vidalin, they note that the number of farms where seal hunting was practised numbered 395 around the year 1700. This number decreased to only 243 at the end of the 18 th century. These numbers apply to only three out of the four quarters that

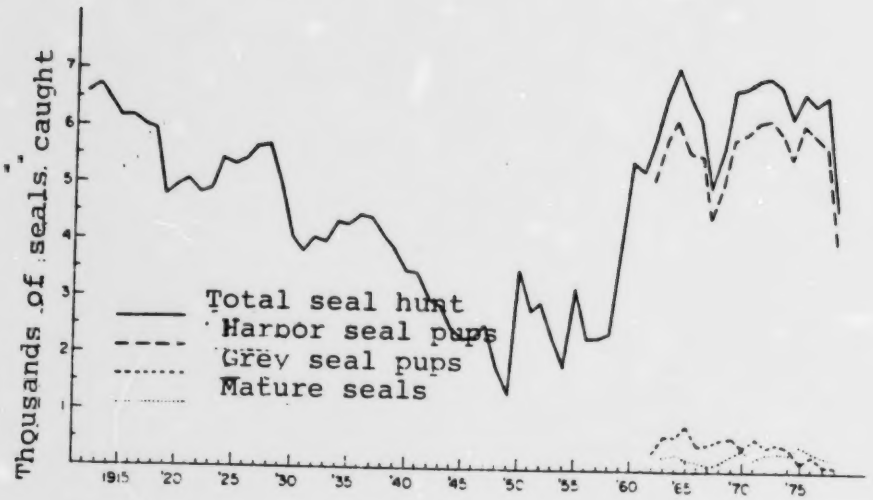
the country is traditionally divided into; East Iceland was not included.

It must be assumed that seal hunting was common in Iceland from the time of settlement; this activity was always considered a privilege. During hard times seal hunting saved people's lives. The following was written around 1590, most likely by Bishop Oddur Einarsson.

> Seal hunting has frequently been a blessing to the people of this country, but especially in the year 1565, when many had been hard hit by a terrible famine (p. 111).

The hunt varied between years. Sometimes migratory seals, especially the harp seal, ringed seal and hooded seal, appeared in numbers and were aggressively hunted. These species were common in years when sea ice reached the shores of Iceland. They provided the population with much needed food, as the ice usually brought hard times.

Old sources do not provide sufficient information on the total Icelandic seal catch; data has only been collected since 1897 (see picture 4).



Picture 4.

Number of seals caught in Iceland 1912-1978. Division by species exists only from 1962. (Solmundur T. Einarsson 1978, Náttúrufraedingurinn 48, Picture 4 p.139. Published with the permission of "Náttúrufraedingurinn" ("The Naturalist").

In the period 1897-1919 the average catch per year was 6000 seals. Following this period the catch has fluctuated considerably, caused by the changes in the price of seal pelts, climatic changes and natural causes, and changes in society. Diseases in the harbor seal also had their affect, for example the seal disease of 1918 that sharply decreased the seal population (Karl Skirnisson and Gudmundur Petursson 1983). The

catch increased in 1960-1978 when 6000-7000 seals were caught each year. Since then, and following a drop in the price of seal pelts, the catch went all the way down to a low of 2000 seals in some years. After the Ringworm Committee started granting a bounty the catch went up again with 4500 seals caught in 1982 (Erlingur Hauksson 1984a) and a similar number in 1983 (Bjorn Dagbjartsson, personal interviews).

Catch reports did not separate pups and mature seals until 1962, by which time, however, the hunting of mature seals had nearly ceased. In the years 1962-1971 harbor seal pups made up 88.2% of the total catch (Teitur Arnlaugsson 1973). Pups constituted the majority or 76% of the seals that were hunted for the Nematode Committee in 1982. However, in 1983 the percentage of mature animals was higher (Bjorn Dagbjartsson, personal interview).

The seal is today caught for different purposes than before. In centuries past and until the first part of this century seals were hunted for their meat and oil, while the skin was used for making leather. With changes in society in the past 50 years or so, consumption of seal meat more or less stopped. However, the skins were processed for export. The result was that hunting of mature animals, which provide the greatest amount of meat and have the largest skins, nearly ceased as their pelts can not be used in the making of modern fashion wear.

The hunting methods used are various; some of them not very pleasant. The main methods include: spearing, stunning the

seals with a blow, using gill nets, using seine, shooting and other tricks for catching the animals (Ludvik Kristjansson, 1980).

2.3 The preservation of seals and encouragement of seal hunting

Various regulations and laws were passed in Iceland on seal hunting in past centuries. The reasons for passing them were various: sometimes the purpose was to ensure authority over what was then considered a rich resource. On occasion official authorities discouraged hunting for the purpose of increasing the seal population; while at other times they encouraged hunting with bounties to ensure continuous use of the resource.

Jónsbók (an ancient Icelandic book of law) includes a section on the preservation of seal breeding areas. According to these laws, only permit holders and owners of the areas could hunt seal.

2.3.1 The shooting of seals

At the end of the 17th century Pall Vidalin states the following in his book "Deo, regi, patriae" :

> It is best to spear seals rather than shoot them with firearms, as the light and noise from the gun scares them (pp. 257-258).

According to Ludvik Kristjansson (1980, p.392) this is the oldest source he can find on the hunting of seals with firearms. He states that the use of guns for this purpose was

probably uncommon in this period and that it was not until the beginning of the 19th century that firearms were commonly used in the seal hunt. He states the following:

> All sources agree on the point that where firearms were used for seal hunting, the seals in the breeding grounds decreased rapidly in numbers. The clearest example of this existed in the southern part of Breidafjördur Bay, where farmers from nearly all the islands and most of the farms hunted seal pups. In the period 1827-1842 the hunt in this area nearly ceased because of the steadily increasing use of firearms. (p.393)

From the first part of the last century and onwards, conflict has existed over the use of firearms for seal hunting. In 1816 a royal declaration was put forward for the purpose of discouraging seal hunting with firearms. Seals could no longer be shot in what were termed "preserved areas". Individuals could, however, designate a hunting area with an official "preservation announcement", which took place during census registration meetings held under a sheriff's authority.

Because of the rapid decrease of seals in breeding areas where firearms were used, in the Mýrar area around 1830 firearms for seal hunting were only allowed along the most distant offshore rocks. In this area the attitude toward seals changed after 1860; the holders of salmon fishing permits, believing that the seals damaged the salmon fisheries, attacked them with guns. On the other hand,the owners of seal breeding areas and the holders of seal hunting permits wanted the use of firearms for seal hunting banned. When the reformed advisory

Althingi (the Icelandic Parliament) met in 1845, a request arrived from the Strandir area pleading that seal hunting with firearms be banned. In 1847 a bill concerning hunting was passed in parliament; it was accepted by the Danish king with few changes. The following is an except from that bill:

> It is hereby illegal to shoot harbor seal or grey seal in fjords and coves; or anywhere within a distance of half a mile from seal breeding grounds . (Laws on hunting in Iceland 1849, p. 13).

A parliamentary committee commented the following in July of 1953:

> ... the benefits from hunting seal by traditional means on breeding grounds are many times greater than the benefits reaped from hunting seal with firearms. Shooting destroys the efficacy of traditional hunting measures such as the use of seine and cutting and stunning them with a blow in the breeding areas. The seal in the breeding areas is like the eider-duck and domestic animals; a creature that humans reap a variety of benefits from. It should therefore be protected from hunting with firearms . (Thorkell Johannesson 1948, p.209).

In 1855 the King declared that seal hunting with firearms be banned in the Breidafjördur Bay area. The area was later made smaller because of the argument that no seal breeding grounds existed in the outer part of Breidafjördur Bay, and shooting the seal was the only method of making use of migratory seals in this area. In 1925 a bill was passed on <u>Laws regarding the shooting of seals and killing them by traditional means in Breidafjördur Bay.</u> These laws still exist. Article one states:

> From now on all hunting of seal using firearms is prohibited in Breidafjördur Bay along with the fjords that extend from it. No hunting of this nature shall take place within a boundary that is marked by an imaginary line extending from the mountain Eyrarfjall located south of Breidafjördur Bay, through the island Stagley ; while from there on the line goes past Oddbjarnasker skerry at around half a mile past it, and ends at Bjargtangar cliffs in Bardastrandasysla county. It is completely prohibited for anyone but the owners or caretakers of the grounds to kill them with clubs or spears.

2.3.2 Salmon fishing and seals

Around 1860 the attitude towards seals changed because of the increasing profitability of salmon fishing. This change was reflected in new conflicts in Parliament. Dr. Jón Hjaltalin, the surgeon general of Iceland, was the strongest opponent of seal preservation in the Parliamentary sessions of 1859 and 1871. His main arguments were:

> ... the seals cause sizeable damage to the salmon fisheries in this country as they eat fish in rivers and river mouths. The seal hunt has until now been much more profitable than the salmon fisheries, as seal pelts and oil received a good price in foreign markets while salmon was rarely exported. Recently, however, the demand for salted salmon in foreign markets has increased and the price for it has gone up. This has resulted in an increasing interest in salmon fishing (Thorkell Johannesson, 1948, p. 211).

In Parliament in 1881, Holger Clausen claimed that the fisheries had been damaged by the preservation of seals. Conflicts arose around the Ölfusá and Thjórjá rivers, as in

these areas some farmers held permits to fish salmon while others profited by hunting seals.

> What made the conflict worse was the fact that public knowledge on the spawning habits of salmon and trout increased around 1880. This new knowledge gave rise to the idea that it was inconsistent to protect the seal, now considered damaging to the salmon fisheries, while funds were also expended on spawning and breeding salmon and trout. (Thorkell Johannesson, 1948, p. 214).

Bills were presented in Parliament in 1893 and 1895 which included drastic measures for the extermination of seals. Jón Jónsson presented a bill concerning extermination of seals in 1895; it included the sentence: "No restriction exists on killing seals anywhere in Iceland". Apparently the purpose of the bill was to protect the salmon from seals. Thorkell Bjarnason protested and called the bill "Foolish, and the worst and most damaging bill ever to appear in Parliament" (Thorkell Johannesson 1948, p. 217).

Around the same time a suggestion was made in Parliament and later approved unanimously, that national statistics should be collected on salmon and trout fisheries; while whether an extermination of seals would increase the salmon fisheries was also to be examined (Thorkell Johannesson 1948). After the examination was finished, a parliamentary committee examined the findings and declared that as seals damaged the salmon fisheries, it would be correct and necessary to encourage the complete destruction of the seal population around Iceland. A bill presented by the committee was narrowly

defeated. The bill would have lifted all restrictions on seal hunting in fresh water fishing areas. A special arbitration commission would, however, have had to decide if seal breeding grounds were also to be destroyed (Thorkell Johannesson 1948, p.218). In Parliament, debates raged from 1889 to 1930 on whether compensation should be paid for seals killed in rivers where fish were caught.

In 1912 a bill was passed allowing county committees to decide, by a 2/3 majority, if they wanted seals destroyed in trout and salmon rivers. The holders of seal hunting permits were to be paid full compensation. The following years saw increasing conflicts on whether seals should be protected or destroyed in light of the effect of the seals on the salmon fisheries. Parliament passed a bill in 1932 allowing free hunting of seals in river breeding grounds, if they were closer than seven kilometers to the mouth of a river, while in 1937 a bill was passed on Laws for the extermination of seals at Húnaós (the mouth of an Icelandic river). The following is a part of article 1.

> The fishing society of Vatnsdasá river has the sole right to exterminate seals from Húnaós. The society's board is to hire one or more persons to perform the task.

These laws are still in force.

Following this, conflict still existed on the seals' effect on the salmon fisheries. It was noted that when seals were chased out of the river Ölfusá, their numbers increased in the river Thórsá. However, despite this the salmon catch in

Thjórsá increased. Olafur Thorlaksson, a farmer at the farm called Hraun in the Ölfus area, suggested in 1952:

> ... that the seal should be protected completely in the Ölfusá river for 10 years if in this period no concrete evidence appears from scientists of its harmful effect upon river fishing. (Gudmundur Danielsson, 1969, p.175)

During discussions on this suggestion the following argument appeared: by keeping predatory fish away from the mouth of rivers the seals protect the salmon fries while they are traveling along their migratory route down to the sea. The seals chase salmon up into the rivers and also move them from glacier rivers into spring-fed rivers.

In the present laws concerning salmon and trout fisheries, no 76 from 1970, similar views appear on the role of seals.

On the extermination of seals

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Seal can be hunted or chased away from lakes where fishing exists, and from river mouths or deltas, if no special legal limitations exist on such activities in the area.

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1. The Minister can declare, following both the advice of The Hunting Committee and The Director of Hunting Control, that seals from profitable and previously protected breeding grounds should be exterminated in lakes, if they are located 7 km or less from the migratory routs of salmon and trout. However, this should only be done after an examination has shown that

profit from salmon and trout in the river is greater than that from the seal hunt.

2. The Minister can declare, following the advice of The Director of Hunting Control that profitable seal breeding grounds or areas where seals are caught in nets should be exterminated even when existing profits from the salmon and trout fisheries in the area are lower than the profits from the seal hunt. However, in cases of this nature action should only be taken where successful breeding of trout and salmon has taken place and it can be shown that future profit from the fishing of fresh water fish will become higher than that of the seal hunt.

2.3.3 A bounty for the killing of seals

The authorities have occasionally granted bounties to those who catch seals in seines or nets. A royal proclamation in 1789, when Iceland was under Danish rule, stated that a bounty should be granted; the amount was highest for mature animals in areas where seals were infrequently hunted. In traditional seal hunting areas the bounty was only granted after 50 seals had been caught. No bounty was paid for female seals nor for pups. The Royal Danish Agricultural Society also occasionally granted bounties to Icelanders. The logic behind this was to encourage the killing of seals for human consumption.

A new chapter opened in the history of Icelandic seal hunting following the discovery of the seals' place in the life cycle of nematodes that infect ocean fish. With this new knowledge, the views put forward became similar to those expressed after the increase in salmon fisheries in the 19th

century, when the interests of the holders of salmon fishing licenses were at the forefront. The seal had become a pest, while until then it had been considered beneficial to the farmers. This shows that attitudes towards seals change according to perceived interests at the time. In 1982 a bounty was again granted for seal hunting. This time it was the Nematode Committee, an organization made up of members from the sea fisheries, that agreed to pay the bounty. The money comes directly from the Icelandic fish processing associations.

Aside from the emphasis placed on the role of seals in spreading nematodes, the view is frequently expressed that the seals eat ocean fish that would otherwise be harvested. This idea has probably influenced attitudes toward seals in the last few decades. This opinion is, however, not new; it was expressed in discussions in Parliament in 1881 and 1883. Another point heavily debated there was the idea that seals could chase fish away from the fishing grounds.

A resolution from the 40th annual meeting of the Fisheries Association of Iceland (Fiskithing Fiskifélags Islands) concerning seal hunting can be seen as a focal point of contemporary ideas of encouraging seal hunting.

> The 40th annual meeting of The Fisheries Association of Iceland wishes to stress its previous emphasis on the necessity of decreasing the seal population around Iceland. The association also emphasises that a bounty should be paid for each seal killed. Nematodes constitute an increasing problem for the fisheries of this country. It is therefore necessary to decrease the number of seals quickly. The annual meeting of The Fisheries Association of Iceland feels that parties

> within the fishery and farming sectors are best qualified to act on the matter. In order to make this possible, the authorities must also show an understanding and provide support to those who wish to take action. (Anonymous, 1982a).

Those concerned with this matter appeared very impatient. The following was stated by a speaker at the meeting of the Fisheries Association:

> As I stated previously, my opinion is that not enough information is available. The Nematode Committee is active, and has, I believe, just held a meeting in New York. I am certain that better material than I have here can be obtained. However, it is also difficult for me to see that anything can be achieved by endless reading. The time has come to act. (Benedikt Thorarensen, 1982, p.24)

If a decision has been made to bring about a reduction in the seal population, modern requirements would call for a thorough ecological knowledge of the place and function of seals and other relevant creatures in the biological worlds of sea and fresh water. Any funding for the reduction of the seal population must be justified by biological and ecological findings. This brings up the question: what is known for certain, and what actions can be justified by this knowledge? The following sections will seek answers to this question.

2.4 The life cycle of nematodes.

Nematodes are a kind of round worm that include the trichina. They are parasitic for at least part of their life cycle. The number of existing species is thought to be close to

half a million (Laverack and Dando 1979), and they can be found in animals, plants, soil, mud and water.

The life cycle of parasitic organisms is complicated, as they have developed a close relationship to other organisms. Commonly a parasite can not go through its life cycle, from ovum to maturity, without infecting another species of animals or plants. In intermediate hosts the parasite developes into a new stage. Sometimes more than one intermediate host is required for completion of the life cycle. The organism where a parasite reaches maturity is called the final or definitive host.

Roundworms in fish are nematode larvae. The fish act as intermediate hosts for a number of nematode species. The name roundworm derives from the fact that the worms grow in a circle in the flesh of the fish.

Considerable attention has been drawn to worms in fish species that are harvested in Iceland because of their effect on the sale of fish products. Considerable research has been done since 1940 on the life cycle of nematodes, especially in The United Kingdom, Canada, and Norway.

Codfish around Iceland are mainly infested by two species of nematodes, Phocanema decipiens and Anisakis simplex, the former being more common. It has been found that seals are the final host for P. decipiens, while the final host for A. simplex are whales.

P. decipiens lives in the stomach of seals and reaches maturity 20 days after the larvae enter the seals. When this stage is reached, the nematode leaves the seal with the excrement. Research has shown that considerably more worms exist in the grey seal than in the harbor seal. However, research on what happens to the ova has proved difficult, but it is believed that they are eaten by crustaceans, which are later consumed by fish. It is difficult to examine the role of crustaceans in the spread of nematodes and consequently much on this remains unclear. (Picture 5)

Picture 5. The life cycle of P. decipiens.

More knowledge on the life cycle of the nematode is an important requirement for answering questions on the exact relationship of the worm to its environment and on how it infects harvested fish species. More ecological research will undoubtedly answer these questions.

The campaign in Iceland against the seals is based on their role in the life cycle of the nematode and on an interpretation of the importance of the size of the seal population. In section 4 these matters are discussed in more detail.

2.5 Diseases from seals

Hunting seal can be dangerous. Seal hunters are sometimes infected by diseases from the seals. The causes of these diseases are unknown, but can result in maiming of the joints. The following description by Dr. Halldor Steinsen, a physician, of a case of this nature at St. Joseph's Hospital, Reykjavik, appeared in 1982 (from Laeknabladid, The Physicians Journal, 1983, vol. 69).

> The patient is a 64-year old male. On the 18th of June 1982 he cut his left thumb on a seal's tooth, which left a small sore. In the next 24 hours the thumb swelled, and a red streak slowly formed along his arm. The patient used poultices with alcohol over the thumb and the swelling subsided after 3-4 days, but it continued to suppurate. On the fourth and fifth days swelling and pain appeared over the left collar-bone, along with pains in the shoulder. The patient's temperature at the time was 38-40 degrees C. The patient stated that he felt he had also been infected by a disease that was going around at the time (p.61).

According to research done outside Iceland, 63% of seal hunters who have been infected acquire infection of the joints if they receive no treatment, while 45% acquire permanently maimed or stiff joints if they get no medical help.

> The causes of seal diseases are not known. It has been hypothesized, however, that the cause is a bacterium transmitted from fish to seals through sores on the skin. This has, however, not been proven and it has not been possible to grow such bacteria in the laboratory.(p.60).

Dr. Halldór Steinsen also stated the following:

> It is certain that diseases from seals can be found in Iceland. Icelandic seal hunters are familiar with these diseases and our patients can name four individuals, all from Strandasýsla county, who claim to have acquired such diseases. Some or all of them have stiff joints as a result. ...
> Seal hunting is a cyclical industry as the price of the skins tends to fluctuate. Demand has been low in recent years and hunting has consequently decreased until this year (1982), when a bounty was granted for the killing of seals. The practise of removing the lower jaw of the seal as proof of a kill should considerably increase the danger of infection from seals as the hunter can easily hurt himself with the teeth of the seal. In the Baltic, a bounty was granted for the killing of seals, and the lower jaw of the seal was used as proof when the bounty was claimed. As a result many hunters became infected by seal disease. This shows that another method should be developed for showing evidence of seal killings. (p. 62).

3.0 Research on seals and nematodes in Iceland

3.1 Research on seals and nematodes before 1974

In 1932 Bjarni Saemundsson published a book called Spendýrin (The Mammals), where he explained the biology of seals around Iceland. However, before 1972, there was little Icelandic research on seals. In 1972 and 1973 the following people wrote reports and articles on seals and related nematodes: Jonbjorn Palsson (1972), Teitur Arnlaugsson (1973), Arnthor Gardarsson (1973), and N.E. Platt (1973). These marked the beginning of considerable research on seals and nematodes that went on for the next few years and which have added to our knowledge of the biology and ecology of these animals.

3.2 Research on seals and nematodes since 1974

In 1974 a committee was formed by the Fisheries Association of Iceland, in cooperation with The Ministry of Fisheries. It was named the Seal Committee and its main task was to examine the relationship between the seal population and nematode infection in fish, along with finding solutions to the nematode problem. The following organizations had representatives on the committee: the Fisheries Association of Iceland, the Agricultural Society of Iceland, the Nature Conservation Council, the Icelandic Fisheries Laboratories,

and the Fisheries Division of the Federation of Icelandic Co-operative Societies.

From 1974 to 1979 the following persons wrote reports and articles on seals and nematodes: Arnthor Gardarsson (1976, 1977), Bjorn Gunnlaugsson and Arnthor Gardarsson (1977), Erlingur Hauksson (1979b), Jon Eldon (1977), Jonbjorn Palsson (1974, 1975a, 1975b, 1976, 1977, 1979), N.E.Platt (1975, 1976) and Solmundur T. Einarsson (1977a, 1977b, 1978).

The Seal Committee turned in a report to the Minister of Fisheries in 1978 where the committee's findings were presented along with suggestions for future actions based on these findings. The committee's conclusions and suggestions are interesting. The following are direct quotations from the report called "An Examination of Seals Around Iceland - the report of a committee formed for the purpose of examining the seal population around Iceland and suggesting how seals can be exploited" (Eyjólfur I. Eyjólfsson et al. 1978).

> As has been mentioned in this report, considerably more research must be done on the seal population around the country. Most of the research tasks that were mentioned are too large for this committee to complete in any valid manner. There is uncertainty about the size of the seal populations, especially that of the grey seal. The result is that not enough clear information exists on the number of seals in certain areas, nor on changes in the population from year to year. Changes in human habitation and economic activity in the last few decades could have had an effect on the number of seals; possibly the grey seal population has increased substantially due to these factors.
>
> Information is also needed on age distribution, and on fertility and mortality rates of the two

seal species that live around the country. Such information can not be obtained except by collecting large samples for research. It is also necessary to examine the movements of seals, for example by marking them. It is also clear that more research is needed on the feeding habits of the seals, in different seasons and areas.

Detailed research is now in its final stages on the life cycle of the nematodes. However, more research is also needed on the infection of seals by nematodes, with special focus on nematode species, age and area.

It is, however, also the opinion of the committee that its own research is a basis for future research and that it has substantially contributed to the existing knowledge, while its work should be of much use in the future. It is clear that the present seal population, or rather the population of the last few years, has caused serious infection of fish by nematodes; which is seen as a very serious matter by the fishing industry. The claim has also been made by those associated with fish processing that the worm problem has been increasing. Even if this is the case it need not be seen as definite proof of an increase in the seal population. Changes in the migration patterns of fish along with an increase in inshore fishing could have played a part in increasing the worm problem. (p. 16)

If this is compared with the direct costs that the fishing industry must bear from the worm problem, and even if inconveniences and indirect costs (such as buyers' complaints and the amount of fish consumed by the seals) are not taken into account, it can still be easily justified that more funding should be provided for research on the seal population and examination of the effects of efforts to decrease their numbers in certain areas. Even if it may not be sensible to take action to decrease the number of seals before the effects are known, it must also be considered that the results of actions taken can only be known through experiments (which would involve shooting seals). This can, however, be difficult both because seal hunting rights are commonly considered the privilege of some Icelandic farmers and because biologists

lack information about the seal population (p. 18).

Experiments of this nature should be performed in designated areas. It is also necessary that research on the seasonal movements of seals be examined so that interpretation of the data becomes easier. The seals caught should also be used for research on age distribution, maturity and fertility, along with feeding habits and number of nematodes. Based on the findings of the report, the committee wishes to suggest the following to The Minister of Fisheries:
The Marine Research Institute, The Biology Research Institute of the University of Iceland, along with any other offical research institutions that perform biological and ecological research, should continue or increase research on the seal population around the country. The nature of how this research should be performed is explained in more detail in the appendix (20). Special attention should be given to the following points:
1. That a large sample should be collected from both species for analysis of fertility and age distribution and for collection of information on mortality. A sample of this nature should also supply better information than now exists on seal feeding habits and the rate of nematode infection in both seal species. By limiting the sample to certain areas, the information gained could throw light on the effectiveness of the measures to decrease the seal population.
2. To organise regular identification of individual common and grey seals for the purpose of (a) examining the annual movements of the two populations and (b) gathering information on mortality rates.
3. To gather information annually on the number of seals, for example in Faxaflói Bay and along the south coast, so that any changes in the populations can be noted.
4. Thorough research on the nature of nematode infection of groundfish. (pp. 18-20).

The Seal Committee was disbanded in 1978, but a year later the Nematode Committee was formed. The new committee has only partly followed the advice of its predecessor.

The Nematode Committee has worked on research on seals and nematodes; reports were finished but never officially published. As is commonly known, the committee has taken action to decrease the number of seals.

The following persons have directly or indirectly published reports or review papers on seal and nematode research: Bjorn Dagbjartsson (1982), Erlingur Hauksson (1979a, 1980a, 1981, 1982a, 1982b, 1982c, 1983, 1984a, 1984b, 1984c), Erlingur Hauksson and Bjorn Dagbjartsson (1982) and Asbjorn Dagbjartsson and Erlingur Hauksson (1980).

The following section will discuss the formation and work of The Nematode Committee.

3.3 The Nematode Committee

3.3.1 The formation of the committee

The Nematode Committee was formed on the 16th of August 1979, by The Minister of Fisheries. The managers of the following companies make up the committee: The Fisheries Division of the Federation of Icelandic Co-operatives, the Union of Icelandic Fish Producers, the Iceland Seafood Corporation, the Icelandic Freezing Plants Corporation, and Coldwater Seafood Corporation, along with the director of the Icelandic Fisheries Laboratories, Bjorn Dagbjartsson , who is also the chairman of the committee. When the committee was formed Bjorn Dagbjartsson held the position of Deputy Minister of Fisheries (see Picture 6)

August 16th 1979

The Ministry of Fisheries assigns you, following the recommendation of the Federation of Icelandic Co-operatives, to a committee that has the task of directing research and experiments that are meant to solve the problems nematode infection presents for the Icelandic fishing industry.

The tasks of the committee will include a close examination of everything related to the following matters; the life cycle of the nematodes; propagation and means of preventing nematode infection of fish; and also ways of locating worms in the fish flesh and removing them. The committee is also to direct research that has already started at the Marine Research Institute on the seal population around Iceland.

The following is a list of the other committee members: Bjorn Dagbjartsson chairman of the committee, Gudjón B. Olafsson, Hjalti Einarsson and Thorsteinn Gislason.

Picture no. 6. The Nematode Committee's letter of commission.

It is interesting to note that all the members of the committee except the chairman are representatives of parties with interests in fish processing. The Marine Research Institute, The Biology Research Institute at the University of Iceland, and other official research institutions that perform biological and ecological research (see suggestions of the Seal Committee just quoted) do not have representatives on the committee. An important difference between the Nematode

Committee and its predecessor, the Seal Committee, is that biologists had representatives on the earlier committee, while they have no one on the present committee.

In the Nematode Committee's letter of commission the following is stated:

> The tasks of the committee will include all aspects of the following matters; the life cycle of nematodes, propagation and means of preventing nematode infection of fish; also ways of locating worms in fish flesh and removing them. The committee is also to direct research that has already started at the Marine Research Institute on the seal population around Iceland (authors underlining).

The fact that the Ministry of Fisheries assigned a committee representing parties with interests in the fishing industry must be seen as a violation of the Laws on research for the benefit of the economy that were in force at the time. The following is stated in article 17 of the laws:

> The following are among the tasks of the Marine Research Institute:
> 1. Research on data on fluctuations in the populations of Icelandic marine animals and their effect on the size of the fish catch, prospects for fishing and maximum use of the catch. Also research on animal species and other resources of the sea which are presently not exploited.
> 2. Research on the habits and living conditions of marine animals and plants... The Marine Institute should be the only party that performs the tasks mentioned and which are done on behalf of the Icelandic government.

In July, 1982, the Federation of Icelandic Environmental Associations wrote a letter to both the Nematode Committee and the authorities. The Ministry of Fisheries was asked to explain its connections with the Nematode Committee and was also asked

whether it approved of the committee's actions. On June 12, 1982 The Ministry replied as follows:

> The committee has done research on the seal population and turned in reports. As an extension of the work it had finished, the committee decided to take it upon itself to grant a bounty for seal hunting. The bounty will be paid by the aforementioned sales agencies of the fisheries. The Ministry of Fisheries was not consulted before that decision was made. In view of the fact that expenses are entirely paid by the sales agencies the Ministry has seen no reason to interfere in the matter.

On this point the following must be noted:

1. The Ministry of Fisheries formed the Nematode Committee and assigned members to it; consequently the members must be official employees.

2. The research on the seal population that was started by the Marine Research Institute was without any doubt done on behalf of the government. Despite the fact that by law the Marine Research Institute should alone perform research on the biology of seals, the Nematode Committee was given the jurisdiction to direct such research. The Marine Research Institute was never consulted, neither on the formation nor on the work of the Nematode Committee; not when the Minister formed the committee; not when he gave it jurisdiction over part of the research of the Institute, nor since (see picture 7).

THE MARINE RESEARCH INSTITUTE

Skúlagata 5

Reykjavik 20 December 1985

The Icelandic Society for Nature Conservation

Skólavordustigur 25

Reykjavik

Concerning the letter from the Icelandic Society for Nature Conservation of December 7th signed by Haukur Hafstad Director.

As far as I know the Marine Research Institute was not consulted on the formation of the Nematode Committee.

No cooperation has taken place at all between the aforementioned committee and the Marine Research Institute on seal research around Iceland.

Yours sincerely

Jon Jonsson

Director

Picture 7. The letter from Jón Jónsson, director of the Marine Research Institute, to the Icelandic Society for Nature Conservation.

3. Shortly after its formation, the Nematode Committee hired a biologist. The Icelandic Fisheries Laboratories provide him with facilities. The director of the laboratories is also the

chairman of the Nematode Committee. The laws concerning research for the benefit of the economy define the tasks of the Fisheries Laboratories (article 26). They do not mention that the laboratories should take part in ecological research on marine mammals, which is logical as the same laws state (article 17) that research of this nature should only be performed by the Marine Research Institute. Even though the Nematode Committee pays the wages of its employees, it is unlikely that the committte pays for facilities and assistance needed in research; for example use of equipment, rent and typing. These and other needs must therefore be paid for by the government. The authorities are clearly responsible for the formation and work of the Nematode Committee and it is in their power to dissolve it.

3.3.2 The operations of the Nematode Committee.

As mentioned, the Nematode Committee was formed in August, 1970. In November of the same year, the committee's biologist turned in a report; "Research on the nematode problem as of the end of 1979 and plans for further studies" . The final section of the report starts as follows (Erlingur Hauksson 1979a, p.9, authors underlining):

> As explained, research on the nematode problem is difficult and will require time. This is not uncommon,however, in ecological research. It should be kept in mind that because of the proposed actions to decrease the number of seals, special attention must given to all matters related to seals and seal research. Seals are

> marine mammals which the public has, either in nature or in zoos, close contact with. Severe criticism can be expected from the Nature Conservation Council, nature preservation societies and even the majority of the public if actions against seals are not based on scientific findings from biological research. It is consequently necessary to perform general biological research on the seal population around the country, so that clear answers can be given to criticism from the opponents of these actions .

It is interesting to note the words:" ... because of the proposed actions to decrease the number of seals.." It shows clearly that from the very beginning the decision had been made to decrease the number of seals. The research on seals performed by the Nematode Committee did not start until the same month as the report in question was finished. This leads one to believe that the research was not seen as important, and was performed to soothe the public. Attention should also be given to the sentence: "It is consequently necessary ... so that clear answers can be given to the criticism from the opponents of these actions". The statement appears to imply that the object of the research is to justify actions to decrease the seal population. One would presume that it is impossible to tell beforehand if the conclusion will provide ".. clear answers to criticism from opponents" or not. Conclusions of research could just as well be expected to support the criticism from the opponents of the actions.

A few reports involving research already finished by the Nematode Committee have been presented. The reports were clearly marked: "No quotation without permission of author".

Others were stamped "Confidential" and had a comment written on them "Please note: rough draft. Author's rights reserved. No photocopying, no distribution". It should also be noted that employees of a number of biology laboratories were denied copies of the reports, making it impossible for them to add to the few available sources that exist on seals around Iceland. From this it should be clear that it is not surprising that Icelandic biologists ask the question: what is being hidden? Why has the Nematode Committee chosen to isolate the information it has acquired?

The committee's methods go against statements by the biologist Erlingur Hauksson, in his review report on the position of seal research. The report was submitted to the Nematode Committee shortly after its formation. The following is a direct quotation from Erlingur Hauksson's report:

> Research on seals and nematodes has been performed by various institutions, including the Marine Research Institute, the Biology Research Institute, and the Icelandic Fisheries Laboratories. Close cooperation should be maintained with these institutions and they should even be directly encouraged to continue working along similar lines; by for example providing them with small grants and financing projects. Inevitably, when proposed actions for decreasing the seal population start, the Icelandic Society for Nature Conservation and nature preservation societies will have to enter the picture. It is preferable for the research that nothing should arise that would damage cooperation between these parties; that would only delay solutions to the problem (Erlingur Hauksson 1979a, p.11).

The board of the Icelandic Society for Nature Conservation decided to form a three-man committee to examine the matter.

Access was permitted to reports of the Nematode Committee under the condition that no quotations be allowed from them unless the committee's biologist was consulted first. The Nature Preservation Council has also been allowed access to the reports and has submitted the following comments on them:

The Nematode Committee has directly violated scientific working rules and customs when it:

> -Decided to decrease the number of seals before it started research on their habits and the connection between seals and nematodes.
> -Decided beforehand that findings from its research would have the role of answering criticism from those who oppose decreasing the seal population.
> -Prevented access to its research before it started action, and did not seek the opinion of biologists other than the one employed by the Nematode Committee.

This brings up the question: Is it not abnormal that a committee, formed by official authorities, should deny the public access to research on the country's resources and environment; research that the committee clearly bases its actions upon, actions that concern the whole nation?

4.0 The biological basis for the actions of the Nematode Committee

Before deciding whether it is necessary to decrease the number of seals, research should first examine whether a reduction in the seal population will actually decrease nematode infection in fish. A decision of this nature must be based on sound knowledge of the habits of seals and nematodes. The problem is twofold; the first and more important issue is whether enough knowledge exists to justify a decrease in the seal population; secondly it is not clear if the attempts to decrease the seal population will work.

What would be a normal research process on the nematode problem and its relationship with seals? How should a firm, usable basis of knowledge be built? The following could be done. It is clear that nematodes in the flesh of fish create problems for the marketing of fish, and it is also clear that seals are hosts to some species of nematodes. The following questions should be addressed.

1. Does a connection exist between seals and nematodes in fish? If research provides a positive answer to the question, then the next question would be;
2. What is the connection between seals and nematodes in fish? This question is very complicated and all attempts to answer it would demand time. The question leads to a variety of other questions. Are seals the final hosts of the nematode species that are found in them? Does a connection exist, and if so, what is the nature of the connection between the infection of harvested fish species and the number and distribution of seals? Has the rate of nematode

> infection in Icelandic fish changed in the last few decades? When answers have been given to these questions the final question would be:
> 3. Is it really necessary to decrease the number of seals, and will this decrease result in a lower rate of nematodes in harvested fish species?

The decision to decrease the number of seals can not be justified, neither from the viewpoint of those who have interests in the matter, nor on moral grounds, until sufficient answers have been given to these questions.

The actions of the Nematode Commmittee attack a vital link in the ecology of the sea. Actions of this nature have usually been negative. It is also important that as many individuals as possible can observe the research, provide ideas and suggestions, review the work and influence decisions.

Criticism of seal killings is not solely based on biological facts. There are three other main arguments: ethical viewpoints, concerns with the protection of nature, and the interests of the regular seal hunters. These arguments have nothing to do with the actions of the Nematode Committee (see for example Orn Thorleifsson 1983).

This section will focus on the research that has been done, especially by the Nematode Committee, on the relation between seals and nematodes in fish. We want the public to listen to viewpoints, interpretations and logic other than that supplied by the Nematode Committee. Frequently statements by the committee have been taken at face value, without any examination of their basis. It is clear that the opportunity to

examine matters from different angles has not been provided, as noted in section 3.3.2.

Also, as in any other research, the committee's findings are based on sources that vary in quality and can be interpreted in more ways than one. Consequently, it is important that research be performed by independent individuals and not by those who have direct interests in the matter. Suspicion is aroused by the fact that laboratories and biologists, those best qualified to evaluate findings, were denied access to research reports, a violation of normal procedures in matters of this nature.

4.1 The arguments of the Nematode Committee

In its reports the Nematode Committee never stated clearly the reasons for the need to decrease the seal population. A study of the reports and statements of the Nematode Committee (see bibliography) leads to the inference that the following are some of the main reasons.

1. Seals are the final hosts of nematodes and spread the infection.

2. A relationship exists between the infection of fish (especially cod) and the distribution and number of seals.

3. Nematodes have for the last few decades been an increasing problem in the fishing industry, a trend that has followed the increase in the seal population.

The argument is also frequently heard that seals eat a large amount of the fish from harvested fish stocks, and consequently they are in direct competition with humans. These four points will be examined along with other factors which are of importance to this discussion.

4.2 Are seals the final hosts of nematodes?

First it is important to understand which species of nematodes are being discussed. The common misunderstanding is that there is only one species of what is popularly referred to as "the fish roundworm". Nothing is further from the truth. As stated before it is estimated that close to a million different species of nematodes exist in the world (Laverack & Dando 1979) and many of these go under the name roundworm. Their habits vary considerably.

Fish are intermediate hosts for many species of roundworm (Berland, 1961): this means that the worms must get into fish at a certain stage in their development in order to be able to close their life cycle. In cod around Iceland these are mainly two species of roundworms live. One of them has the scientific name P. decipiens, called in Icelandic large roundworm. The Nematode Committee has named this species the seal worm taken from the genus name, the first word in the scientific name of the worm. Phoca translates seal and nema as thread. The other common roundworm (thread?) is called Anisakis simplex sometimes referred to as little roundworm in Icelandic.

The species names will be used from now on, so that the species can be distinguished. If the reader wants to look up further sources on nematodes he should know that P. decipiens is sometimes called Terranova or Porrocaecum in older sources.

Research confirms that sea mammals (seals and whales) are the final hosts for P. decipiens and A. simplex, that is where the nematodes reach maturity and thereby close their life cycle. Parasites can be very selective about their hosts and can not complete close their life cycle if they are in the wrong animal species. Therefore, if they are found in an animal, that animal is understood as their host.

Mature P. decipiens have been found in both grey seals and harbor seals, along with other seal species that sometimes find their way over to the shores of Iceland (Scott 1953, Scott & Fisher 1958a, Myers 1959, Mansfield1968). The numbers found in whales are, however, very low (Scott & Fisher 1958b). This is a sign of the fact that whales are not the most favourable host for P. decipiens. This is in contradiction to the habits of A. simplex, whose most important final host is the whale, although mature A. simplex have also been found in grey seals (van Thiel 1966, Davey 1971, Margolis & Dailey 1972, Young 1972, Wotten 1973). It is important to keep in mind this distinction in the habits of these two nematode species.

4.3 Does a relationship exist between the number and distribution of seals and the infection of fish?

4.3.1 The distribution of infected fish around Iceland.

Two of the Nematode Committee's reports deal directly with the infection of cod around Iceland (Erlingur Hauksson 1982b, 1982c). The reports were based on cod samples taken around the country.

The main conclusions of the report concerning P. decipiens were:

> Samples from the south coast differed in that the rate of infection was low and few larvae could be found in the fish flesh of each fish. In other areas of the country the infection rate was even . However, it was highest in Breidafjördur Bay, although the difference was not found to be statistically significant (Erlingur Hauksson 1982b: summary).

The report states that the rate of P. decipiens infection was especially high in Breidafjördur Bay. This was assumed to be related to the large seal population that lives there. However, the difference between the infection rate in this area and others was not statistically significant. In other words, the difference was not more than what would be expected by chance. The review article by Erlingur Hauksson and Bjorn Dagbjartsson (1982), however, makes stronger statements than the empirical evidence allows them to do.

> The infection is fairly evenly distributed around Iceland, except in Breidafjördur Bay where it is highest. (p.2)

As a significant difference was not found, it is illogical to draw conclusions of this nature without any reservations at all.

Why does the southwest part of the country have such a low rate of infection? Erlingur Hauksson explains this difference by stating that fish from Greenland, which is more or less free of worms, have migrated over to Icelandic fishing grounds in this area. This explanation could be correct; it was first presented by Platt (1976). It is interesting to ask why fish from Greenland are relatively free of nematodes. Seals are considerably more common along the east coast of Greenland than in Iceland. Species like bearded seal, ringed seal, hooded seal and harp seal are common there, while the total seal population numbers over a million; a number significantly higher than the seal population around Iceland which can only be counted in the tens of thousands. (Scheffer 1958, King 1964, Banfield 1974). Why are fish around Greenland not heavily infected by nematodes? This shows how complicated the relationship can be and how hard it is to state unequivocally that a large number of seals in one area can lead to a high rate of nematodes in the same area.

If the number of seals is the main reasons for a high rate of nematodes infection in Icelandic fish, the rate should vary considerably in the different fishing grounds. A low rate of infection around the south coast is possibly caused by a large number of fish from Greenland. However, seals are considerably less common along the northeastern and eastern parts of the

country than they are along the southern, western and northern parts. The rate of nematode infection should be considerably smaller along the east and north coasts. However, this is not the case. The same rate exists there as along any other part of the country (with the exception of the south coast), according to Erlingur Hauksson's material (see pictures 2 and 3). Factors other than the number of seals appear to influence this relationship. Erlingur Haukssons concludes the following on A. simplex.

> It was considerably more common to find A. simplex samples from Breidafjördur Bay,; the number of larvae in the flesh of the fish was also higher than in fish from other areas (Erlingur Hauksson 1982b: summary).

Whales are the final hosts of A. simplex. If the same conclusion is drawn as the one drawn about the seals, whales should be considerably more common in Breidafjördur Bay than in other areas around Iceland. Information on this is lacking; however it is unlikely that this is the case. Erlingur Hauksson states that beaked whale and porpoise are probably important final hosts of A. simplex around Iceland. This has not been researched at all. Aside from this, it is doubtful that these species are more common in Breidafjördur Bay than in other places around the country. A number of other whale species could spread A. simplex; for example various dolphin species.

Erlingur Hauksson names (1982b) other factors that influence the nematode rate in fish, for example ocean currents, the shape of the coastline, number and distribution

of favourable intermediate hosts, along with how necessary the intermediate hosts are for the nematodes.

These factors are very important for anyone who wants to understand the relationship between the number and distribution of seals and the frequency of infection in fish. Erlingur Hauksson and Bjorn Dagbjartsson (1982) state:

> There is no doubt that seals are the final hosts of nematodes and that they are the most important animal in spreading it to fish. However, not enough information exists on the exact nature of this relationship. The relationship is probably not direct; a reduction in the number of seals would not mean an equal reduction of nematode infection in cod. The seal population must therefore be reduced and kept down to a number that will neutralise its role of spreading nematode infection to codfish. (p.7, authors underlining)

This quote includes the common misunderstanding that all reductions in the seal population would lead to consequent reductions in the number of nematodes in fish. This idea has frequently appeared in newspaper articles. Even though the number of seals would be somewhat reduced, it would still be unlikely that the nematode rate would decrease, as many other factors than seals enter the picture. For example, if the number of intermediate hosts is favourable, only a few seals could be needed to cause a high degree of nematode infection (p. 8). Can sea birds spread nematodes? Very little research has been done to answer the question. If this is the case it would mean that the attempts by the Nematode Committee to reduce the number of seals are pointless. Sea birds would spread nematodes even after the seals had been exterminated.

The possibility also exists that humans are active in spreading nematodes. The offal from processing aboard fishing vessels is usually thrown into the sea and is eaten by birds, fish and other animals. Does this practice spread the nematodes over a larger area than they would otherwise cover?

Picture 8.

This picture of the Nematode Committee's biologist with half a bucket of nematodes that came from one seal only underlines the fact that a low number of seals could cause a large population of nematodes. Decreasing the number of seals might result in increased infection of the remaining seals, thus rendering such actions useless. (Anonymous, 1980, Sjávarfréttir , p. 8 and p. 31. Published with the permission of Sjávarfréttir) (Icelandic Fisheries News).

4.3.2 Infection rate

According to research done by the Nematode Committee, the rate of nematode infection in cod on the fishing grounds off Iceland in 1980-81 was as follows: P. decipiens was on the average found in 70.6 % of the cod samples, while A. simplex was found in 39.5 % . The number of P. decipiens larvae was higher in each infected cod, on the average 8.6 larvae were found in each cod, compared with 1.0 for A. simplex (Erlingur Hauksson 1982b). The frequency of P. decipiens infection was, therefore, higher than that for A. simplex, and more worms were found in each fish if they were infected by the former species. P. decipiens is also a larger worm than A. simplex and easier to identify. Therefore, one reason why the rate of A. simplex infection is found to be lower could be that it is not as easy to spot this worm in the fish.

The number of worms is not a final determinator of the quality of the fish. P. decipiens worms are mainly found in fish muscles, which goes into fillets, while they can also be found in the intestines. However, A. simplex mainly lives in intestines; it can also be found in the flaps, but infrequently in the muscles (Berland 1973, Jonbjorn Palsson 1975a). A. simplex, therefore, causes less damage to the quality of fish products than a similar number of P. decipiens would.

However, other factors must also be considered. According to scientists, P. decipiens and A. simplex rarely exist in the same fish, although both species exist in fish from the same fishing grounds. No adequate explanation of this has been

found, although the differences in the feeding habits of the fish have been suggested as an explanation (Wotten and Waddell 1977).

Another explanation is that P. decipiens and A. simplex can not live together in the same fish. #) If this is correct, the danger exists that the rate of A. simplex could increase if the rate of P. decipiens decreases. The killing of seals could decrease the rate of P. decipiens while increasing the number of A. simplex.

4.4 Are nematodes an increasing problem in the fishing industry.

The statement has been made that because of the increase in the seal population the fishing industry has experienced more nematode problems.

It is only in the last few decades that thorough research has been done on nematode infection of Icelandic fish. The oldest sources on the matter are Kahl (1939) and Cutting & Burgess (1960). Later Platt (1975) examined the nematode rate in fish in a number of places in the North Atlantic and the North Arctic. Around the same time the Icelandic Fisheries Laboratories also performed research on the problem (Jonbjorn Palsson 1972, 1974, 1975a, 1977).

#) Noble & Noble (1971) mention this. "A parasite living in a host can deny another parasite species, perhaps one damaging to the host, access to it" (p.12).

The reports of the Nematode Committee review the findings of this research, along with introducing material collected by the Nematode Committee (Erlingur Hauksson 1982b, 1982c, Erlingur Hauksson and Bjorn Davidsson 1982). Erlingur Hauksson (1982b) provides an overview of these findings in a table. The table is shown on the next page (Table 1)

Table 1. The development of nematode infection in cod from Icelandic fishing grounds #)

Source	Year of sample	% infection *P. decip.* larvae	% infection *A. simplex* larvae	Average number of nematodes in cod (*P. decip* and *A. simplex* larv.)
Kahl 1939 ##)	1937-1938?	9.4	8.6	-
Cutting & Burgess 1960 ###)	1957-58?		31.2	1.5
Platt 1975	1973	55	76	4.8
Jónbjorn Pálsson 1975	1973	72.1	48.3	7.1 (6.1 + 1.0)
The research in this report (Erlingur Hauksson 1982b)	1980-81	70.6	39.5	9.6 (8.6 + 1.0)

If these figures are examined out of context, the conclusion could be made that nematode infection has increased rapidly in the last 40 years. But what does Erlingur Hauksson (1982b) state on the development of nematode infection in Icelandic fishing grounds?

> According to research, nematode infection of cod appears to have increased along Icelandic shores in the last 40 years. However, the reservation

#) Data from Kahl, Cutting and Burgess are from Platt (1975, Table 5).
##) No information is provided on the number of nematodes.
###) *A. Simplex* and *P. decipiens* larvae were not seperated.

> should be made that different methods of data collection and data analysis could have influenced these findings considerably. This could be an explanation for example, of why Platt (1975) reported a considerably higher percent of A. simplex larvae infection than the others who carried out research on nematode infection in cod around Iceland. A comparison of the findings of this research with research done by Jónbjorn Pálsson (1975), suggests that nematode infection has only increased marginally in the last few years. The percentage increase of seal worm (P. decipiens) and A. simplex larvae infection of cod was smaller according to Jonbjorn Palsson, while the average number of seal worm larvae in each fish was higher. The explanation of the differences between his findings and mine does not appear to be a different mix of cod from Greenland. The rate of Greenland cod in Jonbjorn Palsson's samples was around 20 % , while it was 17 % in mine. However, it is doubtful that the differences in his findings and mine are statistically significant. (pp. 12-13).

A comparison of Erlingur Hauksson's comments and the ones appearing in Erling Hauksson's and Bjorn Dagbjartsson's report (1982) shows how findings that are presented with serious reservations are sometimes reinterpreted as concrete findings. The following is stated:

> A comparison with findings from old research on nematode infection of fish around Iceland shows that the rate of infection has increased considerably in the last 40-50 years. (p.3)

In this statement all reservations have disappeared. A concrete conclusion is provided which, although not based on any additional knowledge, is presented in a more believable manner.

As Erlingur Hauksson mentioned himself, differences in methods of collection and analysis create considerable problems

for making comparisons between old and new findings. Erlingur Hauksson also points out that the sources have limitations.

> The small number of samples could have resulted in inaccurate findings and they might only have provided a rough estimate of the percentage of cod from Greenland on Icelandic fishing grounds. A considerably higher number of samples is needed in order to evaluate this percentage in the same manner as Platt (1976) did (p. 11).

As explained before (section 4.3.1), the low percentage of infected fish along the south coast of Iceland is explained by a high mixture of uninfected cod from Greenland with infected Icelandic fish. Jonbjorn Palsson's findings are relevant here. He states:

> Kahl does not name in his article the methods he used to find threadworms (nematodes) in the cod, but I find the explanation of the great difference between the findings of the two studies (Jónbjorn Pálsson and Kahl) to be differences in how thoroughly the search for the larvae was conducted, rather that an increase in the rate of infection since 1939 (p.8, author's underlining).

The nematode rate can vary according to the size of the fish (Erlingur Hauksson, 1982b). The rate increases up to a certain size, after which it decreases. In older research (Kahl 1939, Cutting & Burgess 1960), the size of the fish examined is not mentioned. This means that if they only examined large cod, they would have counted a low number of nematodes. All comparisons are worthless if the size of the fish is not taken into account. It must be concluded from sources available on nematode infection of cod around Iceland, that no concrete

findings exist on whether the rate of infection has decreased or increased.

If the statement of the Nematode Committee is accepted that the nematode rate has increased, could possibly other explanations exist aside from the one that the number of seals has increased? Some of these could be the following:

It has been known for a long time that fish caught inshore have a higher nematode infection rate than fish caught offshore. Inshore fish are on the average smaller. In "Fish and Fisheries" , translated by Jón Jónsson, former director of The Marine Research Institute, the following is stated:

> In the period 1960-64, 19% of the Icelandic cod catch was fish shorter than 70 cm, that is, immature cod... After the extension of the fishing limit to 200 miles... Icelanders catch much smaller (more) fish than before. (p. 102).

This development has continued, and the term "major slaughter of small fish" has been used. The cod caught today are on an average of the size that is usually heavily infected. The fish are generally 4-5 years old and 60-70cm long (see Erlingur Hauksson 1982b). This means that fish now caught are of a size that has a much higher nematode infection rate than the sizes caught before. It does not matter here if the fish come from Greenland or if they have grown up around Iceland, nor do possible increases or decreases in the seal population around Iceland matter.

Another explanation is that changes have taken place in the nature of the cod stock in Icelandic fishing grounds. The

following is stated in the book The Fish and Fisheries (1977):

> In the early 1930's, cod came frequently from Greenland to spawn around Iceland. The result was a high fish catch in Iceland in this period. After the temperature of the sea went up around Greenland, the conditions for spawning became better, so that cod migration from Greenland decreased (p. 100).

Since cod from Greenland is nearly free of infection, and if fish from Greenland represent a smaller percentage of fish caught on Icelandic fishing grounds, infected Icelandic fish would have made up a larger part of the catch. Research might show that nematode infection had increased in fish caught around Iceland. The reason for the high nematode rate would, however, be changes in where the fish came from. The fishing industry has experienced increasing problems, while these have nothing to do with seals.

Changes in the feeding habits of the cod have been named as another explanation. Erlingur Hauksson (1982b) is correct in pointing out that the number and distribution of favourable intermediary hosts can affect the nematode rate in fish. He also points out that the intermediary hosts are important food for the cod.

The last few years have seen a change in the feeding habits of the cod that live on Icelandic fishing grounds. They have fed on less capelin, while the importance of other food has gone up. The cod now eat more crustaceans along with young fish of their own species. Various crustacean species are thought to function as the main intermediary host of nematode (along with fish). This is, however, not clear, and few research findings

are available (see Bjorge 1979). More research is needed in order to understand this link in the life cycle of nematodes.

If cod eat young fish of their own species, this should increase the nematode rate. The same could happen if the cod eat more crustaceans. It is also worth noting that immature cod eat more crustaceans than do mature fish (Olafur Karvel Palsson 1983). A high rate of nematode infection of young cod that lives inshore in sea-weed is common and serves to prove this point.

Breidafjördur Bay is frequently discussed in the context of high nematode infection in Icelandic fish. Erlingur Hauksson (1982b) found a higher rate there than existed in other parts of the country, although the difference was not statistically significant. One explanation of higher nematode infection rates in Breidafjördur Bay, if they exist at all, is the number and distribution of favourable intermediary hosts. Bjorge (1979) found that Idothea function as intermediary hosts for nematodes. Many inshore crustacean species probably function as hosts for nematodes, for example various species of shrimp. These crustacean species are an intergral part of the beach and inshore fauna of Iceland. The number and distribution of crustaceans is in direct relation to the size of the shore. Over half of the area of the country's shores exist along Breidafjördur Bay (Agnar Ingólfsson, 1975). The number of crustaceans is, therefore, most likely much higher in Breidafjördur Bay than in other parts of the country. This should logically lead to a higher numbers of nematodes.

Statements have appeared in the newspapers and other media alleging that the increase in nematode infection around the country has been so great that it has spread to other fish species than cod, for example haddock, halibut, lumpfish, and pollock. However, this is nothing new. It has been known for a long time that nematodes live in many other fish species. The halibut in Breidafjordur Bay, for example, have been infected by nematodes as far back as anyone remembers.

There are other factors worth mentioning. If it is accepted as a fact that the nematode rate has increased in the fish catch in the last decade, could other explanations exist for this than the ones mentioned? One factor was pushed aside when seals were identified as the guilty party: fish-processing technology has developed rapidly. Machinery and tools for identifying nematodes have improved considerably. Increased monetary incentives have led to more rapid indentification of nematodes by plant workers. Finally it should not be forgotten that requirements for sale in foreign fish markets have become stricter in the last decades. Fish fillets exported to the United States, for example, have been subjected to stricter quality control than before. This must have led to a higher conciousness among fish producers, so that the nematodes are now removed with more care.

The question is frequently asked; what is so important about the seals? Seals, as well as cod, have existed around this country long before it was settled by man. All links in the faunal chain have important functions, though some are more

important than others. Much is lacking in our understanding of the role of each link in the faunal chain.

What can the seal's function be? It is well known that beasts of prey do not hunt randomly. The best known examples of this are carnivorous animals that hunt grass eaters on the prairies of Africa. Lions hunt mainly weak animals, those who are sick and wounded. The same probably happens in the sea around Iceland, when the seals hunt fish for food. The determinant of the number of animals in a given area is the amount of food available: this applies to both land and sea. If the seals kill mainly weak, deformed, and wounded fish, their feeding must in the main be positive for the faunal links. Fish heavily infected with nematodes could be easier prey for seals. The seals possibly help to filter out those fish that would otherwise last a little longer and take food away from healthy fish.

The purpose of this section has been to explain the difficulty of interpreting available information about the rate of nematode infection in fish and the weakness in drawing the conclusion that it has gone up in the last few decades. The nematode rate in the catch has possibly gone up, but there could be explanations of this other than nematode infection in seals. The explanation could simply lie in the fact that the catch is made up differently than a few decades ago. The seals need not be guilty even though the nematode rate has increased in the fish catch in the same time period as the seal population has increased. It appears easy to put the blame on the seals, but is it correct?

4.5 Nematodes and the growth speed of individual cod

The slowdown in the speed of growth of individual cod has been a common topic of discussion. The Marine Research Institute wrote an article appearing on Jan 26, 1984, in the daily newspaper "Timinn". The article states:

> ...It was not until 1979 that the growth speed of individual cods witnessed a slowdown; this applied especially to 3-year old and older cod. (p. 7).

The article also puts forward explanations of why the growth speed slowed in the last few years. None of these explanations finds nematodes as the cause.

The Nematode Committee however, has its own explanation of the declining growth speed of individual cod. In a radio interview on December 3, 1983, the committee's biologist was asked:

"What effect do nematodes have on each individual fish?"

The reply was:

> Some nematodes move into the flesh of the fish and stay there. Others go into the intestines and cause extensive damage. A high rate of nematodes in the liver can affect the functions of the organs and the growth of the fish will slow down.

The reporter asked again:

> "Can this even kill the fish?"

The reply:

> It is probably not common for fish to die from nematode infection... .

The director of the Nematode Committee stated the following in the daily newspaper "Morgunbladid" on December 9, 1983:

> If fish are heavily infected by seal worms (P. decipiens), their growth speed can be reduced: However, according to research it appears that nematodes that live in intestines affect the growth of the fish more heavily. It is likely that fish can only tolerate up to a maximum number of nematodes; after this rate has been reached, the fish will die. (p.27)

In Iceland research has not been done on the effect of nematodes on the growth speed of individual cods. The Nematode Committee appears to rely on research done by Dogiel et al. (1958), where the following is stated:

> If larvae of Contracoecum aduncum exist in the liver of cod, the infected organ will become lighter, and the same applies to the fish itself (Bazikalova 1932, Shulman 1948). If a fish 67cm long is infected by only one or two worms, it weighs 2 kg and its liver 175 g; a fish of the same length infected by forty-five to sixty-two worms only weighs 1.5 kg and its liver only 5 g. Consequently, if a fish is infected by C.aduncum, its liver decreases considerably in weight (p.88).

The nematode species C.aduncum is nearly never found around Iceland (Jonbjorn Palsson 1975a).

According to many specialists in the behavior of parasites, the host's condition is frequently poor before it is infested by parasites; it is sick, lacks food, has sores on

its body and other problems. After the health of the host declines further, the infection gains momentum and the parasites overwhelm the host. The hosts, therefore, die sooner then they otherwise would have, thus also shortening the time the fish can take valuable food away from healthy fish. This procedure is similar to the gains fish stocks make when other animals remove weak individuals from them.

On the whole it is relatively uncommon for parasites to kill their hosts (see for example the comments by the biologist earlier in this section). It would not be logical for the parasite to do so. If they killed the host, they would be committing suicide. Parasites are also the result of thousands of years of evolution, which has led to their adaptation to the host , see for example Noble and Noble (1971):

> The parasite and its host must cooperate so that the host remains healthy and does not reject the parasite. They must both fight and tolerate each other. In this manner they adapt to each other, a process which is of mutual benefit (p. 12).

Spokesmen for the Nematode Committee turn this logic around and state that nematodes result in fish that is poorer and weighs less. It is appropriate to let the spokesman of the Marine Research Institute have the last word on the slowing growth speed of individual cod. He is here discussing explanations other than nematode infection for the decrease in the speed of growth in individual cods:

First, larger fish catches can cause a lower average length per cod. Fish born in the same year do not all grow at the same speed. The length of 5-year old fish is for example around 45-80 cm. The largest fish born in any single year are usually caught first. Consequently, fish that grow fast are caught more frequently than those that grow slowly. However, this changes if fishing efforts are increased, as slower growing fish will then be caught more frequently. Under these circumstances the average length of fish of the same age becomes smaller.
Secondly, the cod stock should not be examined without also taking the capelin stock into account, as it is the most important food for cod 40-100cm in length. The capelin stock decreased heavily with increasing summer and fall fishing in 1979 to 1982. This development happened at the same time that the growth speed of individual cod slowed down and less food was found in samples from their stomachs. However, last year (1983) the capelin stock increased considerably, while the effects of this on the cod stock are not known at this time. Finally, conditions in the sea went through rapid changes in the last few years. They have been poor, especially since 1975, even not that good since 1965, with the exception of short "warm spells" in 1972-74 and 1980. The slowdown in the growth speed of individual fish in the last few years has also in no way been limited to cod; the experience has been the same with other fish species such as herring and capelin. It should be noted in this context that the metabolism of the fish slows down in lower temperatures (Jon Jonsson, Morgunbladid Jan. 26, 1984, p.7).

4.6 The number and distribution of seals around Iceland

As has been noted a number of times, the Nematode Committee appears to see the seal population, or rather an increase in the seal population, as a cause of the increase in nematode infection that has been experienced in the last few decades. Section 4.4 explained that it is doubtful that the nematode

infection has increased at all in this period. The question of how valid the sources on the number of seals are, should also be examined. A number of odd statements have appeared on the matter; for example on the number of fish eaten per year by seals. The public should be aware of how unreliable the figures on the number of seals are.

The first person to give an estimate of the number of seals around Iceland was Bjarni Saemundsson (1932). He estimated that the harbor seal population numbered around 1200 animals. This number was estimated from the catch of seal pups. Smith (1966) estimated that the grey seal population numbered 1000, while this figure was pure guesswork. Four attempts have been made in the last few years to evaluate the size of the seal population around Iceland. The findings appear in table II.

Table II. The results of four surveys on the size of the seal population around Iceland

Year:	No of grey seals	No of harb. seals	Source
1962-1971	2000	30-35000	Teitur Arnlaugsson (1973)
1976	8-10000	40-45000	Solmundur T. Einarsson (1978)
1980	2-30000	20-30000	Erlingur Hauksson (1980a)
1982-1983	10600	-	Erlingur Hauksson (1983)

As the table shows, the findings vary considerably. It should also be noted that there are 10- to 20-year intervals between the surveys. If these findings were taken as

valid, they would suggest that the number of seals increased from their average number in the period 1962 - 71 until 1976, especially the grey seals (a four to five-fold increase). According to the figures, the seal population then went down considerably from 1976 to 1980, when the grey seal population then trebled in two years, from 1980 to 1982-83.

However, no one interprets the findings in this manner. The fluctuations that appear in table II could never take place in this short a period in a population of animals that live as long as do the seals. The reasons are among other things, e.g. that the females do not reach maturity until they are several years old, at which time they only have a single pup at a time. Seals also live for several decades. Other factors must, therefore, exist that explain these fluctuations.

These factors lie in the different methods used by the surveys. The surveys done on the seal population around Iceland only provide a rough estimate of their numbers. One result is that the totals always run in even thousands, while it is unlikely that the seal population is as "even" as this.

The methods for counting were the following: (1) evaluations based on the pup catch (Teitur Arnlaugsson), (2) direct counting and estimations from the pup catch (Solmundur T. Einarsson) and (3) direct counting (Erlingur Hauksson). Each method is based on its own premises, and the ways of estimating the total population from available data are not the same. One example of these methods appears in Erlingur Hauksson's findings (1983). The number of seals was found by counting

pups. To estimate the number of mature seals from the number of pups, the ratio between mature seals and pups must be known. Erlingur Hauksson multiplied the number of pups by 3.5 to 4.5, thereby obtaining the size of the total seal population. By using this method, he got the number 7200-13800; his final estimation of the seal population was therefore 10600. The roughness of this estimation can be seen from the fact that the lower number is only half of the higher number. The figures used for multiplying were based on non-Icelandic sources. It was also taken as given that the grey seal population was increasing around Iceland. These premises create considerable problems which affect the final findings.

The only attempt to estimate if the seal population around Iceland had increased was done by Erlingur Hauksson (1980a). He did this by counting seals from photographs taken from an airplane. He compared his own findings (from 1980) with findings from counts in the same areas from 1976 and 1977 (Arnthor Gardarsson 1976, 1977; Bjorn Gunnlaugsson and Arnthor Gardarsson 1977). Erlingur Hauksson estimated that, from 1976-77 to 1980, the seal population had on the average increased 2% per year; this was said to have been the experience everywhere around the country, except along the south coast.

Many problems exist with these findings. The average increase of 2%, is very low and variations between regions so great that the number is probably not statistically significant. This is even more likely if various error-causing factors and reservations that affect the findings are taken

into account. Despite the fact that attempts were made to use similar methods, errors were likely caused by the following:

1) Harbor seals and Grey seals can not be distinguised from aerial photographs. As a sizeable number of seals was counted, mistakes in counting could easily lead to a 2% variation. (2) The seals were not always counted in the same seasons of the year. This can cause errors, because the seals behave differently in different seasons; for example how long they stay ashore at a time varies with the seasons. (3) Some of the counts were done from the shore, from boats, and others (most of them) from the air. The findings fluctuate according to the method used. (4) The same individuals did not do all the counts. As Erlingur Hauksson (1980a, p. 5) points out himself, experience and training of the eye are important for counting from an airplane. As different individuals did the counting, the counts were probably not always done in the same areas. (5) The time of day can have important effects on the count, especially differences in the tide. Many fewer seals can be seen during high tide, as the seals are then looking for food.

These factors, taken together, can easily cause a 2% variation, which later is interpreted as an increase in the seal population. The data are used to make statements which are not supported. It should be noted that these surveys are the best available. However, they are not good enough for them to be used as a basis for important decisions on decreases in the seal population.

It is interesting that according to the surveys the number of seals along the south coast appears to have decreased (Erlingur Hauksson 1980a). As the shores are wide in this region, and the seals are not hidden by seaweed, it is much easier to count them as compared with other areas of the country. The count along the south coast should be more exact than in other regions. Is it possible that data from the south coast are the most important for telling us about the seal population around Iceland? Is it possible that the number of seals has decreased in the last few years?

As has been shown, statements on the rapid increases of the seal population are based on weak foundations. The Nematode Committee has not hesitated to state that the seal population around Iceland has increased rapidly. This has been done even when the committee's biologist has been more cautious and includes, in his reports, serious reservations on any statement concerning increases of the seal population. The statements by the committee on this matter are, however, an important source of the support it has gained among the Icelandic nation.

It will not be judged here whether the seal population has increasead or decreased around Iceland, as existing documents on the matter are insufficient. Statements in the last few decades on great increases of the seal populations are only based on the subjective opinions of those who have lived in the same area for a long time. It has frequently been stated that increases in the seal population are inevitable following the decreased hunting of seals. Seal hunting is, therefore, viewed

as keeping the population in balance, like the slaughter of sheep in a slaughterhouse; if no more seals are killed, other things being equal, the population must increase.

Less hunting does not necessarily result in an increase in the seal population. Much depends on the nature of the hunt, mainly whether the hunting catch was greater than the fertility of the seal population. For more on this, see in the appendix, a report by Eysteinn Gislason from Skaleyjar in Breidafjordur Bay which he submitted to the Iceland Society for Nature Conservation:

> Despite a great decline in the traditional seal pup hunt, the harbor seal population does not appear to be increasing. At least in some places, there appear to be fewer pups on the breeding grounds compared with a few years ago.

Eysteinn Gislason feels that the reason why the harbor seal population has not increased is that lumpfish nets catch more seals than before.

Despite the fact that accurate counts are not available, there appears to be agreement that the grey seal population around Iceland has increased in the last few decades. It has, for example, been pointed out that in the first part of this century they were never seen in the north of Iceland (Bjarni Saemundsson 1932). Now, however, they breed in various places along the north coast.

What is perhaps not taken into account is that this could merely be related to the migration of grey seals. People usually only have experience of seals from a few areas, and even though some areas have experienced an increase, this can

not be generalized to cover the grey seal population as a whole. Seals can migrate for various reasons. Around 1920 the climate in Iceland became warmer. The grey seals prefer warmer sea temperatures, and Iceland is on the edge of the area where they can live. This could be a reason why the grey seals have migrated north of the country. Also, this century has seen a great transformation in where people live in Iceland. Whole areas have been deserted, for example the northernmost part of the Strandir area, where large grey seal breeding grounds now exist. Boat traffic has increased greatly in traditional grey seal areas in Faxafloi Bay and Breidafjordur Bay. The grey seals are more scared of humans than the harbor seals and therefore breed on distant offshore rocks. The breeding grounds are now not as isolated as before. Before, the breeding grounds were seen as valuable assets and they were protected. An example is that farmers in Breidafjordur Bay who had hunted seals for a long time, started shooting them last summer and fall (1983) for the purpose of obtaining the Nematode Committee's bounty and selling the meat to fox and mink farms. The fathers and grandfathers of these men fought hard to have the breeding grounds protected against hunting with firearms. They were successful when a bill was passed in 1925 forbidding the shooting of seals in Breidafjordur Bay. The laws are still in force.

4.7 The feeding habits of seals

The Nematode Committee states in one of its reports:

> The Nematode Committee is only concerned with the seal because of its role in the life cycle of the seal worm [*P. decipiens*] (Bjorn Dagbjartsson 1982, p. 2).

The same report also states:

> It has not been researched thoroughly [if seals are in competition with humans], and how much of harvested fish species the seals eat around Iceland can change from one period to the next (p.2).

Despite this statement the Nematode Committee does not hesitate to announce the following:

> The Nematode Committee wishes to note that [the consumption of harvested fish species by seals] is equivalent to hundreds of trawler loads each year. (Bjorn Dagbjartsson 1982, p. 2).

Statements like this one are frequently heard from parties with interests in the fishing industry and also from fishermen (see for example a resolution from the annual meetings of the Fisheries Association of the last few years). Announcements of this nature are common, not only about seals but also other animals like black-gulls and whales, but never about the fish themselves.

Despite the statement of the Nematode Committee that it is not its business to determine if seals are in competition with humans over harvested fish species, the committee is still ready to release announcements which set down definite policies on this matter. They support a common notion, that all predatory activity is bad. Man himself is, however, never

identified in this context. Apparently, if problems appear, someone guilty must be found other than man.

> The task [of removing nematodes] will become very difficult, while it would be much easier to shoot the seals. Besides infecting fish with nematodes, the seals eat large volumes of fish. This is something that should be of concern after the news that cod from a whole year is lost (authors underlining). From Svarthofdi (a columnist; comment by translator) in the daily DV, nov 19 1982, p.4)

4.7.1 Information on the food of the seals

Four reports have appeared on the feeding habits of Icelandic seals (Jon Eldon 1977, Jonbjorn Palsson 1977, Asbjorn Dagbjartsson and Erlingur Hauksson 1980, Erlingur Hauksson 1982a). The predecessor of the Nematode Committee, the "Seal Committee", pointed out that it would be necessary to perform, along with other research, thorough research on what seals around Iceland feed on (see p.18).

The following is a review of the main findings of the four reports. It should be noted that the data in the reports are of three types: (1) % of frequency, which shows how frequently the food in question appears, as a percentage of total samples. (2) % of rate, which is the number of individuals of a species consumed. (3) % of weight, which is the percentage of the weight of each type of food of the total consumed. The methods used are important for later interpretations of the findings, especially if the effects of seals on the food stocks are to be examined. In the following table, the most important food species have been underlined. The number of samples taken is given in brackets.

I. Jon Eldon (1977): (grey seals: 6 animals, 51 excrement samples; harbor seals: 20 excrement samples). The findings are presented in table 3.

Table 3. The main food of grey seal and harbor seal. The species that the seals feed on are ranked according to their importance, from top to bottom. The data were analysed according to the % of frequency method.

Grey seal:	Harbor seal:
Ammonidytes lancea	Cod and related species
Shell fish	Flat fish
Flat fish	Acanthocottus scorpius
Cod and related sp.	Cat fish
Cat fish	Lumpfish
Other fish species	Ammonidytes lancea

As can be seen from these data, by far the most important food of grey seals are Ammonidytes lancea and shell fish. Cod and related species were, however, most common in the food of harbor seals, although there was no great difference between the frequency of this compared with other foods.

II. Jonbjorn Palsson (1977): (Grey seals: 9 animals examined, harbor seals: 49 examined). The main findings are presented in table 4.

Table 4. The main food of grey and harbor seals around Iceland. The data were analysed according to the % of frequency and % of weight methods. The species that the seals feed on are ranked according to importance, with the one most frequently found at the top.

Grey seal		Harbor seal	
% frequency	% weight	% frequency	% weight
Cod and related sp.	Capelin	Capelin	Capelin
Capelin	Demersal sp.	Cod and rel. species	Ammonidytes lancea
Flat fish	Flat fish	Ammonidytes lancea	Cod and rel. sp.
Red fish	Cat fish	Flat fish	Flat fish
Cat fish	Red fish	Other	Red fish
Other	Other	Red fish	Other

This survey did not reveal great differences in the food of harbor seals and grey seals. The most important finding was that seals feed on what is easiest for them to get at each time. It is interesting that Ammonidytes lancea was not found at all in the stomachs of grey seals, while Jon Eldon (1977) found it to be the most common food in his survey.

III: Asbjorn Dagbjartsson and Erlingur Hauksson (1980):

(Grey seal: 11 animals examined, harbor seals: 19 animals).

The main findings are presented in table 5.

Table 5. The main food of grey and harbor seals. All three methods were used in analysing the data. The species that the seals feed on are ranked according to importance, with those most frequently found at the top.

Grey seal

% frequency	% rate	% weight
Cod	Ammodytes lancea	Cod
Ammodytes lancea	Cod	Lump fish
Lump fish	Shrimp	Cat fish
Scallops	Other	Other
Other non-vertebrates		
Other		

Harbor seal

% frequency	% rate	% weight
Cod	Ammodytes lancea	Cod
Ammodytes lancea	Cod	Ammodytes lancea
Limanda limanda	Pollock	Pleuronectes platessa
Red fish	Lycodus vahlii	Red fish
Pollock	Limanda limanda	Pollock
Other	Red fish	Limanda limanda
	Other	

The survey shows that there was not much difference between what harbor seals feed on, as compared with grey seals. The authors of the report point out that seals eat mainly fish and that they do not seem to be very particular about what they consume.

IV. Erlingur Hauksson (1982a): (Grey seals: 44 animals, 7 of them had empty stomachs; harbor seals: 109 animals, 32 of them had empty stomachs). The main findings are presented in table 6.

Table 6 The main food of grey and harbor seals living around Iceland. The findings are presented using all three methods.

Grey seal

% frequency	% rate	% weight
Cod	Ammodytes lancea#	Pollock
Ammodytes lancea#	Herring	Halibut
Lump fish	Capelin	Ammodytes lancea#
Other non-vertebrates	Cod	Herring
Limanda limanda	Pollock	Cod
Acanthocottus scorpius		Lump fish
Eupagurus		Todarodes sagittadus
		Pleuronectes kitt

Harbor seal

% frequency	% rate	% weight
Ammodytes lancea#	Ammodytes lancea	Cod
Cod	Cod	Merlangius merlangus
Limanda limanda	Merlangius merl.	Ammodytes lancea #
Other non-vertebrates	Limanda limanda	Limanda limanda
Eupagurus	Other non-vertebrates	Halibut
Hyas araneus		Pollock
Nereis pelagica		Cat fish
Lycodes vahlii		Limanda limanda

also includes Hyperoplus lanceolatus

The table shows how variable the final findings can be depending on the methods used. A difference was experienced in the food taken by harbor seals as compared with grey seals.

However, the food of both, according to this survey, are the main harvested fish species in Iceland. On the other hand, this does not say anything about the effects of the seals, whether they are positive or negative, on the size and growth of the fish. Erlingur Hauksson (1982a) states in a report:

> If the effects of the seals on the size of fish stocks is to be known, it is important that further surveys be done on the feeding habits of seals around Iceland .(An extract)

While Erlingur Hauksson realizes this fact, many others think that if seals eat fish, they must have negative effects on the size of fish stocks. This is completely incorrect.

4.7.2 The effects of the feeding habits of seals

Most of those performing research on the feeding habits of seals point out that seals appear to eat what they can most easily get at each time. Also, not enough samples have been taken to allow us to fully understand what seals around Icleand eat. If they feed on what is most abundant and what is easiest to get at each time, it is likely that their food varies with the season and region . Information is still lacking from some areas of Iceland, especially samples taken in winter. If the seals always feed on what they can most easily get at each time, much more research must be done to understand variations in what they eat.

But what are the possible effects of seals on the Icelandic fisheries? The figures that have been put forward on the number of fish eaten by seals are very problematic. Certain premises

have been accepted as given in calculating these numbers; the number of seals, and how much each seal eats per day, which is then multiplied by the number of days in the year. These calculations provide astromically high numbers, and it is understandable that those who believe them have a negative attitude towards seals. However, nature does not function in as simplistic a way as this. It is important to know that factors in nature do not exist in a direct linear relationship. An example of this is that, other things being equal, 8000 seals do not necessarily have four times as much effect as 2000 seals.

Various factors enter the relationship between seals and the fish stocks: the total seal population; the number of seals in each age group (the age distribution); their growth; feeding habits of seals by seasons; their feeding habits by time of day; their feeding habits at different ages; the most important food species consumed by seals; the percentage of harvested fish in the seals' diet, etc. Some of these factors will be discussed.

Little is known about the age distribution of seals. The Nematode Committee must, however, have data on this from the last two years; the period when hunters had to turn in the jaws of killed seals in order to claim the bounty. The age of a seal can be identified from its jaw. It is, however, not possible to say if the jaws reflect the real age distribution of the seal population. It is not equally easy to catch seals from all age categories. For example, the pups are the easiest to catch,

and 3/4 of all jaws received from hunters in 1982 were from pups.

What could the age distribution tell us about feeding habits? Asbjorn Dagbjartsson and Erlingur Hauksson (1980) rely on non-Icelandic research when they state:

> The findings apparently tell us that these seal species are mainly fish eaters. They, however, eat more non-vertebrates when they are very young and also when other food is scarce. (p.5)

It is important to know for how long pups eat non-vertebrates. As is known, a very small fraction of the Icelandic fisheries depends on non-vertebrates (such as scallop and shrimp). Seal pups, however, constitute a great part of the seal population. This means that the food of mature seals should not be used as the basis for calculating the diet of the total seal population. The diet of pups should be taken into the equation (along with that of other age groups, if their feeding habits deviate markedly from the average for the population).

Little is known about the growth of seals. Information only exists on animals in captivity, which is not comparable with circumstances in nature. In captivity the seals have, for example, enough food and do not need to waste valuable energy in hunting for it.

In addition, little is known about changes in the feeding habits of seals. Some scientists say that the seals fast over the breeding season. This would decrease the amount of food that each seal consumes over the year.

Nothing is known about how a seal spends its time through one day. Many factors would influence its behavior: the tides, weather, time of year, sexual maturity level etc. Erlingur Hauksson states (1982a):

> Examinations of the daily behaviour of seals show that they apparently hunt for food once a day; while they rest on shore after they have finished each trip. They appear to hunt during the night and at dawn, but rest during the day. (p. 8).

Considerable information exists on the size of the animals seals feed on. Larger seals apparently hunt for larger food. Differences can, therefore, be expected between grey seals and harbor seals of the same age, as the latter are smaller. Surveys show that seals eat mainly immature individuals from harvested fish stocks around Iceland; which means that the seals eat fish smaller than those caught by fishermen. Erlingur Hauksson (1982a) points out that the number of immature fish eaten, can affect the age distribution of the species through influencing how many individuals reach maturity and multiply. The seals also eat small fish of species not caught by Icelandic fishermen. However, herring, lumpfish, and capelin are exceptions; seals eat mature fish from these fish stocks. Erlingur Hauksson states that seals are direct competitors of humans for herring, lumpfish, and capelin.

The question arises; do the seals decrease the number of fish of the sizes caught by fishermen? This is not necessarily the case. Predation thins the fish stocks. Thereby the seals could be performing a positive function, for example by

removing weak individuals, which otherwise would live longer and take food away from healthy fish.

The removal of immature fish has considerably less impact on fish stocks than the removal of mature fish. The reason is that many years elapse (4 to 14 years, varying with the individual) before a cod can reproduce and add to the stock. The number of eggs in each female cod depends on the size of the fish. Each cod produces millions of eggs but only a fraction of them grow to the spawning stage. What happens to the eggs and the fries that come from them? They are destroyed for various reasons, for example eaten at various stages of growth by those fish species that are harvested in Iceland. There is a fundamental misunderstanding about this matter.

> "According to biologists, the seal population eats roughly 100 thousand tons of food from the sea per year. Of this around 30 thousand tons is cod", states Gunnlaugur Finnsson (F) ... In addition to this, the seals eat mainly young fish which means that they destroy a higher volume of fish that would otherwise be caught by fishermen, even though only a part of the fish they eat would reach maturity... (Dagbladid 13 Feb. 1979, p.8).

The misunderstanding lies in the belief that as the young have not matured into being able to reproduce, it is considered worse that more young fish are eaten than mature fish. Percentage-wise mortality rate of immature animals is much higher than that of mature animals, even when fishing is not

taken into account. Therefore, each mature individual is worth more for the stock than an immature individual would be. Predation does not add to natural deaths. If predation increases, deaths from other causes decrease. A very low percentage of animals reach maturity. The relationship between the number of eggs and changes in the size of the cod stock, does not appear to be strong.

The following is a statement by Einar Hannesson (1982) on salmon in Icelandic rivers:

> It is known that the life expectancy of salmon while in the sea varies from year to year. The number of salmon that go up into the rivers is, therefore, determined in the sea. A relatively small fraction of salmon fry can lead to a large number of salmon in a given year, while double the number of fry would only provide the same number of salmon the next year (p. 31, authors underlining).

Predation results in a higher life expectancy for the fish that remain. They will have access to more food. Predation is, therefore, not necessarily bad for the fish stocks.

Jon Eldon (1977) states in a report:

> If one looks at how few species the Icelandic fishing industry makes use of and compares it with the variety of the seals' diet, it appears doubtful that the seal population around Iceland, which numbers around 30-40 thousand seals, is in competition with humans. The seals also make use of anything that is abundant at any given time, while the fisheries only use fish species that are easily processed . (pp. 4-5).

On the other hand Erlingur Hauksson (1982a) states:

> Many of the most important food species of the seals are fish harvested in Iceland... It is, therefore, likely that seals affect the size of these fish stocks. However, it would be difficult to calculate exactly how great these effects are. (p. 10).

If the effects of the seals on fish stocks are to be calculated, a variety of information must exist. It is not sufficient to state that as seals eat harvested fish species, they must have an effect on the fish stocks.

It is of fundamental importance to know if the Icelandic fisheries would experience an increase in the fish catch if the seal population were decreased or even exterminated. Usually, the results of poorly planned interferences by man in nature have been negative. The idea is common that what seals eat results directly in decreases in the fish catch. This is not so as the seals are an integrated part of the ecology of the sea and have been for a very long time. A variety of other animals also live on harvested fish species, among them the cod itself. Through the centuries, a balance has been struck between these species, where each species, to a great extent, depends on another. Therefore, it is likely that Icelanders would only reap a limited amount from the expected increase in the size of harvested fish stocks after an extinction of the seals. As more food would be available, other animals (sea birds, cod, halibut etc.) could increase their population following decreases in the seal population.

5.0 Nature conservation and seal hunting

5.1 Procedures in matters concerning the protection of nature in Iceland

Laws have been passed twice concerning nature conservation in general in Iceland. First came the "Law on the Protection of Nature", No. 48 from 1956. Article 10 of this law states that the Nature Preservation Council (Natturuverndarrad) should be made up of seven members; the chairmen of the three divisions of the Museum of Natural History (geology, zoology and botany), one person from each of the following organizations, the Agricultural Society of Iceland, the Association of Chartered Engineers in Iceland together with the Chairman of the council, who should be a lawyer assigned by the Minister of Education. The second law is the "Law on the Protection of Nature", No. 47 from 1971, which is still in effect. This law states that the Nature Preservation Council is to be elected by the "Nature Preservation Congress" (Natturuverndarthing), with the exception that the Minister of Education assign the Chairman and Deputy Chairman of the Council. The Nature Preservation Congress is held every third year. A number of delegates meet, including representatives from municipal nature preservation councils, various organizations and associations, and political parties, together with civil servants.

The functions of the Nature Preservation Council do not appear to have changed much since 1956. The percentage of geologists and biologists taking part in it has not increased. This has been the experience despite the complete freedom of

the Nature Preservation Congress (Natturuverndarthing) to choose members to the council. Representatives from a variety of disciplines now sit on the council. The view has been accepted that the council should be made up of people with a broad and thorough knowledge of the environment, also those familiar with nature conservation, along with parties that have interests associated with the solving of problems of nature conservation. The following was stated on the conservation of animals in article 28 of the law from 1971:

> If the Nature Preservation Council feels that animal species should be protected, or that other actions for conservation should be taken in accordance with these laws, it is essential that agreement on matters relating to this should be sought amongst landowners, county boards, and others who have interests associated with such matters.

The article states clearly that various parties should be consulted when actions are taken to protect nature. On some issues boards, which include representatives from the Nature Preservation Council along with parties concerned with the issues in question, have been formed to ensure proper cooperation. Inspectors from the Nature Preservation Council observe the implementation of policies in full cooperation with other parties concerned.

The law, therefore, states that an agreement must be reached on actions related to the conservation of nature between all those having interests in the matter. Consequently, the final outcome is a compromise of attitudes and interests.

It is obvious that the functions of the Nematode Committee, described in this paper (see section 3.3.2), violate the working rules formed in recent years on matters concerning the conservation of nature in Iceland. In this case parties with financial interests are the sole decision makers and are free to take action without consulting others. This has been the experience despite the fact that the Nematode Committee now has authority over matters that touch important areas of Icelandic society; such as the affairs of the Ministry of Farming, of traditional seal hunters, the Marine Research Institute and other research organizations, the Nature Preservation Council, and voluntary organizations concerned with conservation of nature, along with others who find it morally wrong to turn against one animal species in the manner described.

The Nematode Committee has changed its policy on seal hunting. Initially a bounty was only paid for the lower jaws of killed seals. The result of this policy was that dead seals lay scattered all over Icelandic shores in the summer of 1982. The carcasses rotted, presenting a danger to birds including the sea eagle. The public did not like these procedures, as they violated general ecological principles, along with killing animals without making use of them in any way. To meet requirements, the Nematode Committee changed its policy in the summer of 1983; it started paying now for both the jaw and the meat of the seals. Now the committee claimed that it was solving the feeding problems of Icelandic fox and mink farms.

Many, putting aside the doubtful premises of the seal hunt, now found the committee's actions justifiable. The seal killings can, however, not be continued on the premise that seal meat is useful for fox and mink farming.

In the summer of 1982, the Nematode Committee changed again its method of granting bounties for killing seals; more was paid for the meat than the jaws. The farms can no longer use all the seal meat brought ashore, as the meat must only constitute a certain maximum percentage of what mink and foxes are fed. Seal meat is rich in fat, and if used excessively, it has a negative effect on the fox and mink fur.

Large amounts of seal meat are now thrown away after the Nematode Committee pays for it. This occurred in 1982 and 1983. For example, many tons of seal carcasses, stored for a period in the freezing plant in Patreksfjordur (West Iceland), were thrown away. What is perhaps the most negative aspect of the whole affair is that the seals are presented before the public as a pest. For centuries the seals were one of the most important sources of food for Icelanders. In a resolution adapted by the 43 people meeting for the Fisheries Bureau (fiskideild) in the West Fjords the following is stated:

> We conclude, that it is important that seals be killed under inspection and supervision of the Ministry of Fisheries, and registered hunters be assigned, as <u>practised for exterminating foxes.</u> (Halldor Bernodusson 1983: 604, authors underlining).

Some are against the killing of seals for the sole reason that such action is thought to be inhumane (see Gautur

Hannesson 1978). This view should be respected; however, it has not been of significant importance in forming policies in matters concerning seals in Iceland. It is unfair to criticize nature conservationists in Iceland by referring to foreign nature conservation groups that fought against the Canadian seal hunt. These groups are powerful; they have had a strong influence on public opinion and have caused a price drop in seal pelts. Despite their power, these groups have not influenced the debate on seal hunting in Iceland.

In Iceland the concern is mainly over how justifiable it is to start organized action to decrease the seal population. Are such measure in line with modern ideas on ecology and conservation of nature, ideas based on ecological knowledge and an understanding of the place and role of organisms in nature? No one in Iceland has suggested that seals be completely protected. On the contrary, the idea appears to be more common, that normal use should be made of animal species, and that the present marketing problems of seal furs is not a permanent situation.

5.2 The effects of hunting on the seal population.

It is a common misunderstanding that those protesting the seal killings of the Nematode Committee are against all hunting of seals. This is not true, as can be seen in that traditional seal hunting has not been criticized. Moderate use of the seal population does not have to violate principles of nature conservation. Those concerned with the conservation of nature

only wish to prevent a rapid decline in the seal population. The method of killing animals can be said to come more under humanitarian affairs rather than conservation of nature.

For the seal population, as with other long-lived mammals and birds, the age at which individuals die is important for the reproduction of the species. Young animals experience a higher natural mortality rate. But what is the actual mortality rate of seals?. Only the grey seal will be used as an example here. The reason is that this species appears to have increased in numbers around Iceland, while the numbers of harbor seals have stayed the same. The Nematode Committee has also taken a grim attitude towards the grey seals, as they are thought to be more heavily infected with nematodes than the harbor seals. More information also exists on the grey seals.

The natural mortality rate has been estimated for the British Isles, where no seal hunting takes place (Hewer 1974). The conclusion was, that 60 % of all pups die in the first year; including 1/3 to 1/4 in the first month following birth. In the second year 30% of the animals that lived through the first year die. In the third year 12 % die, and then 7% of the females per year. The pattern of the males is not the same. Their mortality rate is the same as that of the females in the first 7 years. However, after that the mortality rate goes up; in the eight year it is 10 %, ninth year 15 %, tenth year 25 % and 40 % per year after that. The reason is that the males must fight over territory and females, thus increasing the mortality rate of older males.

The high mortality rate in the first year shows that hunting of young animals has considerably less impact on the reproduction of the population than hunting of older animals. Also, that hunting of fully grown animals that have not reached maturity (one to six years old) has less impact than the hunting of the same number of animals that have reached maturity. This matter has frequently caused a fundamental misunderstanding. A news article in the daily "Timinn" on Saturday Jan. 14 1984 reviewed protests by the county board in Vestur Húnavatnssýsla county against the seal killings authorised by the Nematode Committee. The article stated:

> The county board wishes to note; that it would have been much better to support the traditional seal hunters, along with those with an income from the hunt, so they could hunt pups for profits. This <u>method of hunting seal must be seen as the best and most realistic way of keeping the seal population from increasing</u> (p.30 author's underlining).

If the stated policy of the Nematode Committee, to decrease the seal population, is to be effective, it would be most realistic to kill only mature seals. As stated, the mortality rate of the pups is so high anyway, that hunting pups, as practised in Iceland, will not decrease the seal population. In addition, it is not likely that traditional seal hunters would want to hunt so much that the population would decrease. Therefore, the interests of the traditional seal hunters are in conflict with the actions of the Nematode Committee. A result of this has been that the farmers have laid down firm protests.

In light of the information mentioned here and historical factors, the possible increase in the seal population around Iceland in the last few decades can be explained. Formerly, when seal hunting was practised in order to obtain meat and skins, the fully grown seals were the ones most frequently killed. In the last few decades seal hunting has been practised mostly to obtain the pup pelts. The hunting of mature seals probably limited the ability of the population to reproduce. At the beginning of the century the grey seal population had probably decreased down to a dangerous level, and the species had been thrown out of balance with the environment. However, when related to changes in society, hunting nearly ceased, and the grey seal population, freed of human killing, started gaining its balance. This is the most plausible explanation of the estimated increase in the grey seal population in the last decades; the increase that has been viewed so negatively by fish processors. The population is only seeking its former balance; once it has been reached, the increase will stop automatically.

Animal populations do not always increase after hunting stops. It all depends on how badly hunting has affected the population in the previous years and centuries.

The reasons why the harbor seal population seems be in balance should be clear after the discussion here. The population is large enough to accommodate hunting; especially as the mainstay of the hunt is only pups. Even if hunting ceased, it would be unlikely that any increase of the population would take place.

5.3 The Seal Hunting of the Nematode Committee

The Nematode Committee started granting bounties in the spring of 1982; it continued granting them in 1983 and 1984. The following figures on the number of seals caught in 1982 and 1983 are according to information from the committee.

	Mature animals	Pups
	1982	1982
Harbor seals	634	2367
Grey seals	488	1154

Total of 4643 seals in 1982

\- - 4000 - 1983

The following problems exist with these figures.

The number of seals killed must be somewhat higher than stated in the table. One reason is that late in the summer of 1982, the Nematode Committee announced that it would stop paying bounties for harbor seals for the rest of the year. Seal hunters still had jaws which they meant to turn in to claim the

bounty. However, they were most likely submitted to the committee in 1983. It is also well known that many seals are shot while they are in the sea and are therefore not caught but instead sink to the bottom. No bounty was paid for animals that were killed in this manner. This is clear from a news article in "Morgunbladid" on the 8th of April, 1983.

> He caught nine seals but lost a few that sank down to the bottom... (p. 48).

It is not easy to estimate the number of seals killed. Their number must be expected to have been closer to 5000, if not higher. However, deductions in the number can also be made; people have found seals that died from natural causes and claimed a bounty for them.

In the summer of 1982 the Nematode Committee was accused of causing uncontrolled killings of seals. S andinavian nature conservation organizations held a meeting in Stykkisholmur (West Iceland) on June 3. The meeting released the following resolution.

> ... the decision of the Nematode Committee, as to its causing uncontrolled seal killing around Iceland, was discussed. We are shocked that methods of this nature are employed in the seal hunt. An extermination campaign of this nature is inappropriate while clear research findings are not available on the seal population.

The Nematode Committee replied as follows:

> The funds available for the granting of bounties is limited; which again limits the number of animals that will be hunted. Therefore, a decrease in the seal population can not be expected. If it is ever felt necessary to decrease the seal population, the number of

> seals that are to be killed must be decided upon in advance. After it has been decided to decrease the seal population, the Nematode Committee will make decisions on the number of seals to be killed (The Nematode Committee, 1982, p. 10).

The procedure described here, namely that a committee of parties that have financial interests in the matter can decide the size of fundings for bounties, is not in accordance with contemporary ideas on the control of fish stocks. The Nematode Committee can decide to pay anything it wants. Could it be true, that parties with financial interests can get together and decide to exterminate an animal species, if they only have the money to do it? The practice outside Iceland is to have independent research parties make suggestions and describe methods for controlling animal populations.

If the total number of seals which the Nematode Committee paid a bounty for was only 4643, the total amount for bounties would have been 1,183,000 kronas. This amount is about 18 % higher than the amount that was to go towards the granting of bounties. The control of animal populations must always be based on a valid estimate of the size of the population. The hunt must be in the hands of chosen hunters, who are subject to the authority of a reliable institution. While the numbers o the size of the seal population and its age distribution are as unreliable as they are at the present, no basis exists for a realistic control of the seal population.

5.4 The result and consequences of the seal killings

In retrospect, the most important question is: have the seal killings authorized by the Nematode Committee had any effect. The committee feels its actions save money, since the money they put into research and bounties should be more than repaid through fish less infected by nematodes. Less efforts in removing the nematodes from the fish would constitute a saving in fish processing. Is this likely to be the case?

If the premises used by the Nematode Committee are correct, it is possible to calculate roughly the profits from the seal killing. The grey seal will only be used in the following examples; this species is looked upon, anyway, as the most dangerous threat to the Icelandic fisheries.

Certain premises are needed for these calculations.

a) The size of the grey seal population. Findings from the biologist of the Nematode Committee from 1982 will be used. He estimated the population to be 10600 mature individuals; and these would breed 2660 pups per year (Erlingur Hauksson 1983, p.9).

b) Mortality rates. Figures on the mortality rates of Icelandic seals are not available. Therefore, figures from England will be used (see Hewer 1974).

c) The state of the population. The premise is given that the population is in balance. It is important for calculations of this nature to know if the population is increasing or decreasing.

As mentioned before, it is estimated that in a population of 10600 mature seals, 2660 pups are born each year. Of the 2660 pups, 1600 (60%) die in the first year, while 1060 survive. This means that if the population is in balance, 1060 mature individuals will die per year; which is equal to the number of pups that live through the first year.

If these figures for the mortality rate , 1600 pups and 1060 mature seals, are compared with the number of individuals which the Nematode Committee paid a bounty for in 1982, it appears that 488 mature animals and 1154 pups were killed. The seals killed, therefore, only constituted 46 % of the mortality rate of mature animals, and 72% of the mortality rate of the pups.

It should be stressed that the seals killed by hunters can not be added to those that die from natural causes. Instead, they should be calculated as part of the original mortality rate. Hunting does not have an effect until it has resulted in a higher percentage of death than would have occured from (normal) natural causes. This means that the seal killings of the Nematode Committee, as practised in 1982, would not at all have decreased the grey seal population. This would especially not be the case if the population is, as many think, increasing; which means that more mature individuals are surviving than the minimum needed to keep the population steady, or that the birth rate of pups is high, or the situation is a combination of these two factors.

The actions of the committee appear pointless, except perhaps to prevent an even more rapid increase of the grey seal population. Would that be sufficient as a purpose in itself? That is doubtful. It has already been explained, that it is unlikely that increased nematode infection in cod would be caused by an increase in the seal population (4.4). Secondly, it is possible that the same number of seals are able to maintain the present nematode rate in fish (4.3.1). It is, therefore, unlikely that the nematode infection rate would go down, even if the seal population were to decrease, let alone if the only results were that the seal population was kept from increasing. Thirdly, it is possible, that nematodes survive by using other final hosts than we at the present know them to use. Fourthly, the A. Simplex nematode, will not decrease with the killing of seals, as it uses whales as final hosts (4.2). In the fifth place, if the seal hunt should result in a decrease in P. decipiens, A. Simplex could increase instead (4.3).

Because of the present situation of lacking information, it would be much more effective to place funds into more seal and nematode research; along with improving techniques of removing nematodes from fish. Improved methods of removing the nematodes can improve the competitive position of Icelandic sea/products in foreign markets, as was done with the Portuguese saltfish market. Improved evisceration can possibly increase the value of the fish, which could pay for more than the increased costs of better processing.

Can the seal killings of the Nematode Committee be seen as harmless, if they do not decrease the seal population? This is not so, as it can not be justifiable that parties with financial interests in the matter are allowed to grant bounties for the killing of an animal species which they have decided is a competitor. Modern procedures in cases of this nature call for ecological research before decisions are made. The case of the seals is a complicated affair. The research that has been done is not sufficient to justify the killings of seals. It has become clear, that the traditional idea that seals have a use value for humans, has been rejected. Instead, seeing them as a pest has been encouraged. Their centuries-old role of being a benefit to humans has now been rejected.

Other ideas of making use of the seals have appeared in the last years. The actions of the Nematode Committee have created a market for seal meat on mink and fox farms. The great increase in the number of such farms in the last years in Iceland has very likely maintained this demand. The mink and fox farmers would probably not on their own be capable of paying the expenses of the seal hunt; they need the support of the Nematode Committee's bounty. Because of the encouraging effects of the bounty, some fur fox and mink farms have sent hunters to supply seal meat food to the farms. Will, in the future, the need of these farms determine the policy on seal hunting?

Despite the fact that the number of seals caught can not be taken as an indicator of any success in dealing with the size

of the seal population, the hunt has still had an effect. Many seals are killed because of the granting of the bounty and are never listed, as they are lost when they sink to the bottom. Considerable indirect effects exist. Shooting in seal breeding grounds have created great disturbances of the same nature as those fought against by traditional seal hunters in the nineteenth and early twentieth centuries. As the seals are an important part of the chain of life in the sea, the effects on the environment are considerable.

At the beginning of this section, a question was asked: are there positive financial gains from the seal killings of the Nematode Committee? It is unlikely that this is the case. As noted, the nematode problem will probably not decrease. There could be a gain in the increased knowledge aquired on the habits of the seals. However, the seal research of the Nematode Committee suffers from the bias of being performed under the protection of parties with financial interests related to the matter. This will create a negative atmosphere toward the reseach findings.

The total expenses of the Nematode Committee in 1983 were around 4.7 million kronas, with most of it going into bounty payments (Morgunbladid, April 25 th, 1984). To give the reader an idea of the size of this amount, it should be mentioned, that the expenses of the Icelandic Museum of Natural History were 5.9 million kronas in the same year. The task of the museum is to do basic research on Icelandic nature, in zoology, botany, and geology, giving it a much broader range of

activities compared with only doing research on seals. The same applies to other research institutions that do basic research on wild animals. It is important to note, that the Marine Research Institute has, without success, tried to obtain funding for research on seals around Iceland. It is unfortunate that the Nematode Committee does not wish to fund impartial ecological research.

A bill has appeared in the Althingi (the Icelandic Parliament) on seal hunting. It should be a positive act to put laws into effect concerning seals and seal hunting. However, as will be explained later, the bill has many problems associated with it. New laws must be followed by a reorganization of seal and nematode research. Impartial parties should direct the research; the Nematode Committee should be dissolved.

5.5 The 1984 bill on seal hunting

The Minister of Fisheries formed a committee in 1982 with the task of writing a bill on seal hunting. The committee includes representatives from The Icelandic Fisheries Laboratories, the Nature Preservation Council, The Agricultural Society and the Ministry of Fisheries. It is surprising that the Fisheries Laboratories have a representative on the committee, while the Marine Research Institute is totally ignored, despite the fact that, according to law, the latter is to handle all research on seals. The reason for this is that the director of the Fisheries Laboratories is also the

director of the Nematode Committee. As noted before (section 3.3.1.) the Marine Research Institute was ignored when the Nematode Committee was formed.

The committee writing the bill finished its work in the spring of 1983. The Ministry of Fisheries examined it for one year, after which it was laid before the Parliament shortly before the closing of parliamentary sessions in the spring of 1984. The idea was that it would be passed quickly before the end of sessions. It became apparent that the Ministry of Fisheries had changed the bill in one fundamental way. Despite the change, the Minister of Fisheries put it forward as if it had arrived from the committee in this form.

The following is the bill, as it appeared before Parliament in the spring of 1984.

LAW ON SEAL HUNTING AROUND ICELAND

(submitted to the 107th session of the Icelandic Parliament, 1984).

1

The Ministry of Fisheries is to direct all matters concerning seal hunting in Iceland; see, however, law no 76 of 1970 concerning salmon and trout fishing.

2

The Marine Research Institute is to direct research on seals around Iceland. If the Ministry of Fisheries wishes to assign individual research on seals to outside parties, it should always make sure that the Marine Research Institute can observe the research process and review the conclusions.

3

The Ministry of Fisheries should consult the following parties on the direction and organization of seal hunting, according to what is appropriate in each instance: the Nature Preservation Council, the Marine Research Institute, the Icelandic Agricultural Society, and the Fisheries Association of Iceland.

4

Only landowners can hunt seals or grant hunting permits to others on their property, except when law state otherwise, see law No 76 from June 16 1970, concerning salmon and trout fishing.

If the property extends down to the sea, the landowner in question is allowed to catch seals with nets, up to 115 meters (measured at lowest tide) from land.

Any Icelandic citizen can hunt seals, in accordance with section 1 of these laws, in areas that are outside private property. They can also hunt seals outside areas where nets are laid, according to section 2; out to the limits of the Icelandic economic zone; in according with law no 41 from June 1 1979, concerning the fishing limit, economic zone and the continental shelf of Iceland.

Otherwise, the right to hunt seals is subject to law from June 20 1849, concerning hunting in Iceland (see especially section 8).

5

Citizens of countries other than Iceland can not hunt seals along the shores of the country, nor can they hunt within the fishing limit or economic zone of Iceland; see the law on the fishing limit, the economic zone and the continental shelf, no. 41 of June 1, 1979.

Exceptions can be granted from paragraph 1 by international negotiations.

6

The Minister can put forward regulations concerning the excecution of these laws. The Minister can act on these laws in the following manner:

1. Prevent seal hunting in certain areas.
2. Restrict seal hunting to certain time periods.
3. Protect seal species and limit the number of seals that can be hunted in an area in certain time periods.
4. Put forward regulations determining the hunting methods allowed and the bore size of firearms that are to be used for seal hunting.
5. Regulate what should be done with the carcasses of killed seals.
6. Put forward regulations on hunting for scientific purposes.
7. If needed, decide methods for decreasing the seal population.
8. Following the approval of the Nature Preservation Council, put forward regulations on seal hunting in areas that have been protected or will be protected in the future, according to law no. 47 from 1971 on the conservation of nature.
9. Put forward regulations that are needed because of the participation of Iceland in international agreements on seal hunting.

7

Violators of these laws or regulations related to them are subject to fines and more severe punishments, if other laws have also been broken. Penal law no 19, from February 12 1940, should be followed in respect to confiscation of the catch, profits from hunting, and illegal hunting equipment.

Fines and confiscated material should go into the State treasury.

Cases related to violations of these laws or regulations should be publicly prosecuted.

8

This law is effective immediately. Older laws are no longer active: law no. 30 from June 27 1925 concerning shooting of seals and traditional seal hunting in Breidafjordur Bay, law no. 29 from June 13, 1937 on the extermination of seals in the Húnaós area, and article 16 of an announcement from June 20, 1849, on hunting in Iceland.

5.5.1 Problems with the bill

Despite the fact that the bill is not long, it includes many faults. To begin with, its name: Law on Seal Hunting Around Iceland. Seal hunting is named especially, without mentioning other selected matters such as seal research and seal protection. The suggestion will be made that the name of the bill be changed to Law on seals and seal hunting around Iceland.

Article 1 of the bill would give The Minister of Fisheries authority over all affairs concerning seal hunting, which would include research on and protection of seals. It is odd that, according to the bill, The Minister should only direct seal hunting. Little attention is given to research and possible actions for protection.

Seal hunting has so far been under the authority of The Ministry of Farming, the reason being the traditional benefits Icelandic farmers have had from seals. The bill would take away the power of The Ministry of Farming to direct the utilization of seals for the benefit of farmers.

Article 2 of the bill authori es the Marine Research Institute to do research on seals. However, according to the same article The Ministry of Fisheries can also hand individual research projects over to other parties, while the Marine Research Institute can observe the research and review the conclusions. There is no mention of any authority vested in the Marine Research Institute to influence the research process

directly. According to the Law on Research for the Benefit of the Economy, that was active until June 30 1984 (no. 54 from 1965), the Marine Research Institute had alone authority over all research on seals, which means that article 2 of the bill changes nothing in the organization of the research. The only thing it does is provide other parties with an opportunity to perform research, while it is odd that this power is in the hands of the Minister who did not consult the Marine Research Institute on the matter. The bill actually legalizes the situation created with the formation of the Nematode Committee in 1979. As mentioned before (section 3.3.1) The Minister of Fisheries formed the Nematode Committee without any consultation with the Marine Research Institute, thereby violating Icelandic laws. To give the Marine Research Institute authority to "follow the research process and examine the conclusions" is no change from the present situation.

Since 1979 the Nematode Committee has initiated large research projects on the biology of seals. A number of reports have been released, which can not be cited without the permission of the Nematode Committee. It was not until 1984, that these reports were sent to the library of the Marine Research Institute, while many research institutes had their requests for the reports denied (see section 3.3.2).

The only change made in the bill, while it was being processed by the authorities, was article 3. It was written in the following form by the committee that originally drafted the bill:

> For the assistance of The Ministry of Fisheries in the direction and organization of seal hunting, The Minister of Fisheries assigns a five-man committee that will function for two years at a time. One of the committee members should be assigned by the Nature Preservation Council, another by the Marine Research Institute, the third by the Agricultural Society of Iceland, the fourth by the Fisheries Association of Iceland, while one member is a delegate at large. The Minister chooses one of the committee members as Chairman.
>
> The committee should be consulted whenever regulations are to be put forward or other decisions are to be taken concerning whatever it sees appropriate concerning the affairs related to the direction and organization of seal hunting.

The change made by the Ministry is most problematic. This is a fundamental change, and if it is accepted, all other articles of the bill are affected. The change gives The Minister considerable power that can be difficult for him to handle, as the bill only provides weak direction on the handling of cases concerning seal hunting. The Minister is actually free to consult anyone he wants. As The Ministry of Fisheries formed the Nematode Committee and did not find any reason to interfere with its actions, one can not expect that he will do anything that will change the present seal hunting situation. The Nematode Committee would thereby strengthen its position.

If article 3 is not changed back to its original form, article 1 must be changed in a manner that will ensure that The Ministry of Fisheries acquire authority over all seal and seal-

hunting concerns. The Ministry of Fisheries should also be required to not act on these matters unless the Ministry of Farming and the Ministry of Education have first been consulted.

Also, article 2 should be changed to ensure that work done outside the Marine Research Institute is always performed with the full cooperation of the institute. Experience has shown, that the Ministry of Fisheries can not be trusted to evaluate who is to perform research on seals. It is immoral to place research of this nature into the hands of parties whose only relation to the problem is direct financial interest; it is necessary to assure by law that only independent parties be allowed to direct such research.

Article 6 states that The Minister can direct the execution of the law through governmental regulations. These can possibly be short-term measures that can be done away with with one stroke of a pen. It would be better to have clear permanent articles on the preservation of rare migratory seals like the ringed seal and harp seal, along with the walrus.

Article 8 states that the present laws regarding seal will no longer be active. Among them are laws on the shooting of seals and on traditional hunting in Breidafjordur Bay (no 30 from 1925). Is it a correct decision to make these laws inactive? The Icelandic Parliament has frequently discussed the shooting of seals; speeches and debates in Parliament are very interesting, especially those from 1845 to 1925. The history of these matters was reviewed in brief in section 2.3.1. Clear

and consistent arguments led to laws regulating the shooting of seals; for example arguments concerning the effects of shooting on the distribution and behaviour of seals in breeding grounds. In light of this, it appears odd, that the present bill before Parliament will wipe out all previous legislation on the matter. The old arguments used for constructing older bills are now forgotten, despite the fact that they were never disproven, and the habits of the seals have not changed. If the seal bill becomes law in its present state, seals can be shot all over Breidafjordur Bay; both in breeding grounds and elsewhere. Laws banning shooting seals in breeding grounds have been in effect continuously since 1816.

One of the saddest effects of the actions of the Nematode Committee is that traditional seal hunters, living beside the areas where shooting has not been allowed, are now themselves starting to use firearms for hunting. They do it to claim the bounty, while also selling the meat to mink and fox farms. The forefathers of these hunters fought for a long time for the passing of the law of 1925. The Reykjavik newspaper DV reviews, on the second of December 1984, comments from a farmer living in Breidafjordur Bay. The farmer stated that he had hired a shooter who "managed to kill 550 seals this summer; which makes 60 tons" (p. 64).

It is neither a normal matter of course nor in any way justifiable to cancel the law from 1925; and also to do it without allowing for any measures to make up for such an action. If shooting is allowed in the seal breeding grounds,

they could be disrupted and the remaining seals move into other areas. Migration of seals into areas where they have not lived before could then give even further rise to statements on increases in the seal population. Those in power could use this to support the idea that the seal population was growing abnormally.

There is no doubt, that laws on seals and seal hunting must be amended; especially those concerning official direction of hunting. The last few years have seen increased problems related to price decreases of seal products and wild shooting of seals for the purpose of fulfilling the Nematode Committee's objective of decreasing the seal population. The comments of the former Minister of Fisheries in 1982, at the 41st annual meeting of the Fisheries Association of Iceland are in line with th

> My position is that the seal population must be decreased. However, this should be done using what I would describe as less offensive measures than those practised last summer (1982). Laws, regulations and permits should be employed to direct these affairs (Steingrimur Hermannsson [Icelandic Minister of Fisheries, comment from translator] 1982, p. 624).

The bill on seal hunting reflects the situation that existed following the formation and actions of the Nematode Committee; it is clear that this situation is now to be legalized. Price decreases of seal pelts, related to changes in fashion, have occured over limited time periods before. The use of seals for fox and mink food has been discussed before, while fox and mink farming is, however, also subject to fluctuations

in fashion. The present bill before Parliament is clearly full of faults; it needs major reexamination; more discussion must take place on it by all those concerned about seals and seal hunting.

As a final comment of this section on the new seal bill, it should be noted that debates rage in Iceland on other wild animals than seals; foxes, mink, reindeer, rats, sea gulls, ravens, eagles, ptarmigan, geese, swans, eider ducks have also caused disagreements. It is important that general laws be written on the organization and direction of research on wild animals in Iceland. Presently, matters concerning these animals come under at least four ministries. Research on wild animals has been fragmentary and subject to the interest of a few individuals. No single party in the official administrative system is responsible for the observation of these animals. Questions need to be answered, such as are the populations of these species increasing, are any of them in danger of extinction, have attempts to decrease their numbers been effective or have they not been worth the effort, etc.? An independent research party should be in charge of this, just like the Marine Research Institute is in charge of how we make use of the ocean and suggests better ways of harvesting it, or Directorate of Freshwater Fisheries looks after the use of rivers and lakes and the State Land Reclamation Centre deals with the use of cultivated areas. This independent research party should handle research on wild

animals and provide well - supported suggestions on the control of these animals.

6.0 Summary

The numbers at the beginning of each paragraph refer to the sections in this paper.

1.0 The objective of this paper is to discuss the Nematode Committee's bounty on seals. The granting of the bounty started in the spring of 1982 for the purpose of decreasing the number of seals around Iceland. It was hoped that this action would lead to a lower nematode infection in harvested fish species.

2.1. Two species of seals breed around Iceland, the harbor seal and the grey seal. The harbor seal breeds in the spring, while the grey seal breeds in the fall.

2.2. Icelanders have practised seal hunting since they settled the country long ago. It was always considered a priviledge to have the opportunity to hunt seals. In the first part of this century, seals were hunted for meat, oil, pelts and leather. With changes in society, Icelanders stopped eating seal meat and instead started processing seal skins for export. With this, the hunting of mature seals nearly ceased.

2.3 Various resolutions and laws have been passed concerning seal hunting in Iceland in past centuries. Hunting of seals using firearms destroys seal breeding grounds. In 1816 a royal declaration was passed for the purpose of restricting the shooting of seals. The law from 1925, which is still in force, bans all shooting of seals in the inner parts of Breidafjordur

Bay. Occasionally, the authorities would provide bounties for hunting seals with gill nets or seines. The purpose of such bounties was to encourage the use of seals for human consumption. In 1982, the granting of bounties for seal hunting started again. The seals had been turned into a pest, and the bounty has been paid by associations of the fish-processing industry.

2.4 Nematodes are common throughout the world, and the number of species is thought to number as many as half a million. The roundworms in Icelandic fish are the larvae of nematodes; the two main species are Phocanema decipiens and Anisakis simplex. P. decipiens reaches maturity in seals, while its eggs and larvae must be carried by crustaceans and fish to be able to complete its life cycle.

3.1 Research on seals and nematodes experienced a considerable increase in Iceland around 1972.

3.2 From 1974 to 1978 the "Seal Committee" was active; it included parties with financial interests related to seals, plus one naturalist. One of the conclusions of the committee was, that an official research institute handling biological and ecological research should continue and take on new research on the seal population around Iceland.

3.3. The Nematode Committee was formed by The Ministry of Fisheries in 1979. All the members of the committee are representatives of parties with interests in the fishing industry, with the exception of the Chairman, who is the Deputy Minister of Fisheries. No biologist sits on the committee, despite the fact that the committee was meant to direct all seal research which had already been started by the Marine Research Institute. This was done without any consultation with the Marine Research Institute and in violation of the laws that existed at the time. The first report of the committee shows clearly that the decision was quickly made that the number of seals must be decreased. The impression was left that the committee's research was of marginal importance, and the same report states that the research is necessary "... to provide ready answers to criticism of the opponents of these actions."

4.0 The case of the seals involves the question whether sufficient knowledge exists to decide whether the seal population should be decreased and whether actions to decrease the seal population will have any real effects.

4.3 The seals spread immature nematodes. The relationship between seals and nematodes is complicated and it is affected by many environmental factors.

4.4 The opinion has been expressed that the nematode problem in the fisheries has increased, following decreased hunting of seals. It is clear that the problems of the freezing plants have increased because of nematodes; however, the reason for this does not necessarily have to be an increase in the seal population. The last few years have seen increased catches of fish of the sizes most heavily infected by nematodes compared with the fish sizes caught before. Higher quality market demands have also led to a more thorough search for nematodes.

4.5 The Nematode Committee has maintained that nematodes are to blame for the decreasing rate of growth of individual cod on Icelandic fishing grounds in the last few years. This statement has not been supported by any Icelandic studies and very few non-Icelandic ones.

A more plausible explanation of the changes in the growth speed of individual cod is the increased fish catch, the poor condition of the capelin stock, along with a temperature drop in the sea around Iceland.

4.6 The Nematode Committee has stated that the number of seals around Iceland has increased following decreased seal hunting. Available sources on the number of seals are too incomplete to support a statement of this nature.

4.7 The studies that have been done on the feeding habits of seals around Iceland, seem to imply that seals are not very particular about what they eat; they appear to take what is available at any given time. The common misunderstanding exists that what the seals eat would directly translate into an increased fish catch if they were exterminated. It is forgotten that various other animals also feed on harvested fish species; they could, because of more available food, increase in numbers if the seal population is decreased. The effect on the fish catch would most probably be minimal or non-existent.

5.1 The practice has been, in matters concerning nature conservation in Iceland, to compromise with parties with financial interests. However, in the case of the Nematode Committee, the parties of financial interests are the sole decision-makers. Icelandic nature conservationists have never asked for the complete protection of seals in the country. A strong emphasis has even been placed on the sensible and normal utilization of seals.

5.2 The seal population will not necessarily increase if seal hunting stops. It would depend on whether the hunt from previous years had been greater or less than the yearly increase of the seal population.

5.3 The Nematode Committee granted bounties for the killing of 4000-5000 seals in 1982. However, it is clear that many more seals were killed than those caught by the hunters. The Nematode Committee feels that it directs seal hunting by deciding how much money it pays out for bounties. An independent research party should direct these affairs.

5.4 It is not likely that the Nematode Committee will reap any benefits from the costly and difficult seal hunt it is directing; this means that the nematode problem of the Icelandic fishing industry will not decrease. The seal hunting of the committee has, however, had many negative consequences. The total expenses of the Nematode Committee in 1983 were around 4.7 million kronas; it is unfortunate that this money should not instead have been spent by an independent research party.

5.5. In the spring of 1984, a bill appeared in The Icelandic Parliament on new law on seal hunting. If the bill is passed without any changes, the present situation will be legalized.

It is important that laws be put forward that would cover all aspects of research and control of the wild animal population of Iceland.

7.0 Sources

The following list includes the sources used in this paper, together with other information on seals and nematodes, along with anything of interest to those who want to examine more closely the case of the seal.

The authors have collected newspaper articles on the subject from the last few years; a list of these is also included.

(Translator's note: In Iceland the practice is to list sources alphabetically by the author's first name, not the family name as is the case in most other languages. In this paper Icelandic sources are listed according to the Icelandic rule; while non-Icelandic sources are listed by the family name of author).

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7.4 Sources from Icelandic newspapers

Althydubladid vol.65 (42), p.2. Isn't it enough to be in love with five thousand seals?

Dagbladid 4 (225), p. 7. Seal killings to protect cod.

Dagbladid 5 (61), p. 8. Must the seals be exterminated?

DV 72 & 8 (146), p. 1 (two vol. numbers are given as DV was formed through the unification of two newspapers). The results of the bounty of the Nematode Committee: ugly seal carcasses.

DV 72 & 8 (160), p. 3. Associations of Icelandic Societies for the Protection of Animals lays charges because of the seal bounty.

DV 72 & 8 (265), p. 4. Let's fight for the protection of the nematodes.

DV 73 & 8 (missing), pp. 14-15 . The seal killings represent fascism against the animal kingdom: stop it immediately.

DV 73 & 9 (19), p. 9. The Norwegians give in to the demands of seal protectionists.

DV 73 & 9 (32), p. 9. The fight for the protection of the seals hits the Greenlanders hard.

DV 73 & 9 (50),. p. 8. The EEC places a two-year ban on imports of seal pelts.

DV 73 & 9 (53), p. 8. The Canadians threaten to retaliate because of the ban on seal hunting.

DV 73 & 9 (77), p. 15. Seal killings this summer?

DV 73 & 9 (83), p. 44. The seal killings give them good profits.

DV 73 & 9 (83), p. 5. Use of lights has become more common in salt fish processing, removing nematodes has increased costs 2-3%.

DV 73 & 9 (89), p. 2. (A text under a photograph). Is this a mistical picture by the painter Kjarval or perhaps ... ?

DV 73 & 9 (93), p. 10 The sale of skins is increasing again after the decline caused by the actions of animal protectors.

DV 73 (104), p. 12. Farmers are protecting their rights.

DV 73 & 9 (131), p. 44. The police "arrested" a seal on the beach.

DV 73 & 9 (139), p. 40 The Taiwanese want Icelandic products; are asking for seal penises.

DV 73 & 9 (140), p. 40. The case of the seal penises is being discussed by the Sealworm Committee. "We might send them a sample" -says Bjorn Dagbjartsson Director about the inquiry from Taiwan.

DV 73 & 9 (140), p. 31. Seal worms? (<u>P. decipiens</u>), Never heard of it. Convenient change of terms.

DV 73 & 9 (144), p. 2. Johanna the seal has arrived in Isafjordur (West Iceland).

DV 73 & 9 (146), p. 2. "I like halibut" - says Johanna the seal, who is now fat and healthy.

DV 73 & 9 (152), p. 1. The nematodes are infecting the cod heavily - seven out of every ten cod are infected by the worm.

DV 73 & 9 (152), p. 4. Erlingur Hauksson, biologist of the Sealworm Committee, states that nematode infection can go up to 90 % in areas where grey seals are common.

DV 73 & 9 (216), p. 40. The seals eat halibut straight off the fishing lines.

DV 73 & 9 (220), p. 14. The Icelandic seal war: "What happened to our concerns and consciousness over the animal kingdom"?

DV 73 & 9 (277), p. 44. An average freezing plant in the West Fjords, Iceland spends over four million kronas to remove nematodes -They are also starting to infect the haddock.

DV 73 & 9 (278), p. 7. The suggestion of the annual meeting of the Fisheries Association of Iceland: The government should declare war on the seals.

DV 73 & 9 (280), p. 40. Kill first and ask questions later - biologists criticise the seal hunting policy of the Nematode Committee.

DV 73 & 9 (281), p. 2. The Director of the Nematode Committee comments on the criticism on their actions: "We followed the same procedures as in Canada and Norway; years of research before seal hunting was encouraged."

DV 73 & 9 (287), p. 2. Questions in the Icelandic Parliament; matters concerning the environment, seal hunting, and the teaching of sign language.

DV 74 & 10 (24), p. 10 "The seals are one of the worst predators" is among statements in an article written on the centennial of Haflidi Eyjolfsson of Svefneyjar (in Breidafjordur Bay).

DV 74 & 10 (73), p. 43. A boat from Husavik (North Iceland) gets an exotic catch: a seal, a farmer and five sheep.

DV 74 & 10 & (91), p. 30 A bill on seal hunting.

DV 74 & 10 (68), p. 10. The Canadians will not let anyone restrict their seal hunt.

DV 74 & 10 (95), p. 5. The nematodes cost 200 million kronas a year.

DV 74 & 10 (165), p. 16. Seal killings.

DV 74 & 10 (263), p. 64. A reindeer hunter shot 550 seals.

Helgarposturinn 4 (28), p.19. The hringyrmlingur (round wormlings) (Translator's comment; the name refers to unknown phenomena).

Morgunbladid 65 (232), p. 19. The Greenpeace people are busy: Their actions have delayed the seal killings.

Morgunbladid 65 (236), p. 1. The seal killings have stopped.

Morgunbladid 66 (60), p. 30. Seals on Icelandic fishing grounds eat more than 100,000 tons of young fish.

Morgunbladid 66 (90), p. 2. Seals eat 30 thousand tons of cod and related species per year.

Morgunbladid 66 (254), p. 2. Discussion at the annual meeting of the Fisheries Association: Is is justifiable to exterminate the seals?

Morgunbladid 68 (271), p. 21. "The seal population should be decreased" -The annual meeting of the Fisheries Association feels that the seal cause billions of kronas of damage each year.

Morgunbladid 69 (48), p. 25. 25 thousand harbor seals and 2,500 grey seals around Iceland.

Morgunbladid 69 (60), p. 18. Will attempts be made to stop the seal hunt by granting bounties?

Morgunbladid 69 (60), pp. 18-19. The increase in the seal population around Iceland has caused increased nematode problems for the fishing industry. Among ways discussed to decrease nematode infection of fish, is to increase the seal hunt and grant a bounty for each seal killed.

Morgunbladid 69 (66), p. 2. Seal diseases exist in Iceland. Hunters should be warned of the danger of removing jaws from the seals they have killed. Among statements in "Laeknabladid" ("The Physicians Journal").

Morgunbladid 69 (119), p.32. 700 kronas for each killed grey seal.

Morgunbladid 69 (126), p. 12. The days of repayment have arrived, says Solmundur Tr. Einarsson fish specialist.

Morgunbladid 69 (143), p. 2. The Mula Parish files charges against the seal killings.

Morgunbladid 69 (145), p. 80. It is not correct that Mula Parish has laid charges against the seal killings.

Morgunbladid 69 (149), p. 12. A bounty paid for 450 killed seals. Criticisms of the Committee are unecessarily harsh, says Bjorn Dagbjartsson. The nordic nature protection organizations state that the seal killings are out of control and unnecessary at the present. Union of Icelandic Nature Protection Associations states that an official statement should be put forward concerning the actions of the Nematode Committee.

Morgunbladid 69 (150), p. 3. The nematodes are now infecting the haddock.

Morgunbladid 69 (151), p. 41. Criticises the actions against the seals.

Morgunbladid 69 (152), p. 34. The Nature Preservation Council states that the seal killings should be stopped.

Morgunbladid 69 (153), p. 21. The Icelandic Bird Lover's Society states that seal carcasses can be death traps for birds.

Morgunbladid 69 (155), p. 5. Wants an examination of the seal killings.

Morgunbladid 69 (155), p. 55. What kind of nonsense is this? (a text under a picture: removing seals from a seine used for the catching of seals in Breidamerkursandur area.)

Morgunbladid 69 (157), p. 76. The attack on the seals must be stopped.

Morgunbladid 69 (157), pp. 18-19, 48. Kristjan Petursson farmer in the Svansvik area: They even shot the seals in the breeding grounds. - 27 seal carcasses are rotting on the beach in Reykjafjord.

Morgunbladid 69 (157), p. 32. An unjust attack on the seals, by Thordur Jonsson.

Morgunbladid69 69 (160), p. 49. The county board of Austur-Bardastrandarsysla states that the laws banning seal hunting have been broken in Breidafjordur Bay.

Morgunbladid 69 (162), p. 40. They are attacking the Icelandic natural environment and spoiling it.

Morgunbladid 69 (166), pp. 44-45. Is overfishing a part of the roundworm problem?

Morgunbladid 69 (171), p. 36. A machine to locate nematodes in fish is being designed.

Morgunbladid 69 (182), p.40. Is it against the Law of nature to eat when you are hungry?

Morgunbladid 69 (189), p. 32. An organization for the protection of nature in North Iceland releases statements on an alumnium factory in Eyjafjord, damming of the Blanda River, and whale and seal hunting.

Morgunbladid 69 (250), p. 48. Among topics at the annual meeting of the Fisheries Association was the idea that boats be

equipped for seal hunting - The local branches of the association agreed on the necessity of decreasing the seal population.

Morgunbladid 69 (252), p. 3. The Annual Meeting of the Fisheries Association; 4000 seals were caught - actions for decreasing the seal population should continue.

Morgunbladid 69 (257), p. 25. A statement by the Icelandic Society for Nature Conservation notes that the actions of the Nematode Committee for decreasing the seal population should stop, and the committee should be disbanded.

Morgunbladid 69 (257), p. 27. The general meeting of the Association of Traditional Seal Hunters in Breidafjordur Bay.

Morgunbladid 69 (257),. p. 43. The seal hunt should continue to be encouraged with bounties; the worms from the seals cost the fishing industry 60 million kronas each year.

Morgunbladid 70 (7), p. 10. The seals have been made into a scapegoat - says Sigrun Helgadottir, biologist, about the de cision of the Nematode Committee to grant bounties for killing seals.

Morgunbladid 70 (21), p. 23. The Barents Sea: The whales and seals eat twice as much fish as fishermen catch; - stated in the Norwegian journal "Fiskaren" ("The Fisherman").

Morgunbladid 70 (27), p. 23. Norwegian seal hunters are concerned: will this be their last hunting season?

Morgunbladid 70 (28), p. 14. How much do the seals eat? The Norwegians want to draw a map of the Barents Sea showing how the seals feed.

Morgunbladid 70 (33), p. 23. We do not kill seal pups -says Jonathan Motzfeldt in a meeting held today.

Morgunbladid 70 (46), p. 2. The seal hunt should come under the jurisdiction of the Ministry of Fisheries. The seal hunt bounty is expected to be paid this year in the same manner as last year.

Morgunbladid 70 (46), p. 17. Icelanders protest restrictions on seal hunting.

Morgunbladid 70 (50), p. 1. The EEC bans imports of seal pup pelts.

Morgunbladid 70 (78), p. 48. Skagafjord (North Iceland): Great seal flocks everywhere.

Morgunbladid 70 (82), p. 34. The worm ship. Not the first time the Union of Icelandic Fish Producers (S.I.F.) gets fish thrown back at it, by Johanna Tryggvadottir Bjarnason.

Morgunbladid 70 (83), p. 48. Nearly 80 people do nothing but locate nematodes in salt fish processing; costs are expected to rise by 80 million kronas.

Morgunbladid 70 (83), p. 25. The removal of nematodes from fish has started in salt fish processing; we do not know the best way of doing this. 350 fish... Costs of removing the nematodes... Increasing numbers of nematodes...

Morgunbladid 70 (85), p. 2. The seal goes ashore in Surtsey.

Morgunbladid 70 (88), p. 38. Nematode-Union of Icelandic Fish Producers; by Johanna Tryggvad Bjarnason.

Morgunbladid 70 (95), p. 32. A bounty for seal hunting and the meat used to feed foxes.

Morgunbladid 70 (102), p. 9. A great mistake to allow the shooting of seals. Kristinn Jonsson, a farmer from the Stranda area, says that catching seals in nets is the only way of fighting them.

Morgunbladid 70 (125), p. 3. The seals in the West Fjords are being counted - A bounty paid for 4,500 seal jaws last year.

Morgunbladid 70 (131), p. 2. An unusual guest.

Morgunbladid 70 (132), p. 2. Hrunamanna Parish: seals in Stora Laxa river 80 km from the sea.

Morgunbladid 70 (135), p. 32. A seal carcass mincing machine has been built -The freezing plant in the town of Hnifsdalur (West Iceland) is expected to use it.

Morgunbladid 70 (135), p. 3. The seal population increases and moves into new areas.

Morgunbladid 70 (137), p. 47. The seals in the West Fjords have been counted: "the seal killings are immoral and pointless" - states Solmundur Einarsson fish specialis.

Morgunbladid 70 (139), p. 45. Let's call the roundworm by its correct name.

Morgunbladid 70 (141), p. 45. A lamb for two seal pups.

Morgunbladid 70 (141), p. 44. We dont need to blame the low temperature of the sea, nor sea birds, for the extermination of harvested fish species.

Morgunbladid 70 (145), p. 44. The best thing to do is to decrease seals and black-backed gulls.

Morgunbladid 70 (146), p. 32. Seals for fox and mink food.

Morgunbladid 70 (146), p. 17 I have never seen an eater like this one, says Torfi Einarsson, who takes care of Johanna the seal.

Morgunbladid 70 (149), p. 44. Stop chasing the seals.

Morgunbladid 70 (150), p. 2. A seal with a salmon in its mouth was seen from the bridge over Olfusa River.

Morgunbladid 70 (150), p. 60 . Seals 230 years ago.

Morgunbladid 70 (151), p. 48. The case of the Icelandic pup pelts.

Morgunbladid 70 (154), p. 33. Products from Icelandic seals: Possibilities for using seal pelts for jackets and fur coats are being examined.

Morgunbladid 70 (160), p. 6. (Text under a drawing), Machine for cutting up seal carcasses has been built.

Morgunbladid 70 (166), p. 44. Seals become more common in salmon rivers.

Morgunbladid 70 (167), p. 48. Thvera River in Borgarfjordur: a seal was shot after it had gone more than 30 km from the sea.

Morgunbladid 70 (167), p. 20. The seal in Thvera River.

Morgunbladid 70 (171), p. 48. Seal hunting in Nordura River.

Morgunbladid 70 (171). p. 3. Less fishing in Nordura River.

Morgunbladid 70 (228), p. 48. More than a hundred tons of seal meat will be used to feed foxes and mink. Half a million kronas have been paid in bounties.

Morgunbladid 70 (228), p. 3. The seal carcass mincing machine is broken; it was defeated by a grey seal carcass.

Morgunbladid 70 (246), p. 26. The seal is hunted for fox food.

Morgunbladid 70 (275), p. 25. Nematode infection increases in nearly all fish species.

Morgunbladid 70 (282), p. 32. Debates on the seal hunting bounty -the tax office wants it to be counted as taxable revenue.

Morgunbladid 70 (283), p. 27 Nematode infection can hamper the growth of individual fish.

Morgunbladid 70 (289), p. 32. The Nematode Committee and the tax office; the bounty should definitely be classed as revenue.

Morgunbladid 71 (13), p. 30. The county committee of Vestur-Hunavatnssysla county feels that it is wrong to grant bounties for seal killings.

Morgunbladid 71 (17), pp. 18-19. A resolution by the Nature Preservation Council: Laws on seal hunting and much increased research.

Morgunbladid 71 (21), p. 2. Olafsvik (West Iceland): The costs of removing the worms 4.4 million kronas.

Morgunbladid 71 (32), p. 31. The Ministry of Fisheries: a bill on seal hunting for meat processing.

Morgunbladid 71 (60), p. 45. Restrictions and bans on fishing: what about the black-backed gulls, seals, and old nets#.

Morgunbladid 71 (67), pp. 76-77. Seals, black backed gulls, old nets: fishermen are not alone in catching fish.

Morgunbladid 71 (73), p. 26. Questions - the damage from nematodes in fish.

Morgunbladid 71 (73), p. 31. "It is easy to find scapegoats" - by Thord Jonsson from the Latrar area.

Morgunbladid 71 (82), p. 45. Seal hunters paid the money of Judas.

Morgunbladid 71 (93), p. 2. The seal hunt bounty: mostly a payment for the meat.

#Comment from translator: the article is referring to nets that have been lost by fishermen, while they keep on catching fish which decay in the nets.

Morgunbladid 72 (85), p. 31. A bill from the government: Seal hunting around Iceland.

Morgunbladid 71 (97), p. 40 -41. Do the seal eat 75 thousand tons of harvested species each year?

Morgunbladid 71 (98), p. 19. The machine to cut up seal carcasses made by the Icelandic Governmental Engineering Works. (Landssmidjan) has been put up for sale.

Morgunbladid 71 (100), p. 14. A price drop in seal pelts.

Morgunbladid 71 (104), p. 15. An afternoon nap (picture).

Morgunbladid 71 (105), p. 41. A seal in Seydisfjordur (East Iceland).

Morgunbladid 71 (141), p. 2. The seal hunt is about to start.

Morgunbladid 71 (153), p. 6. The protection of seal breeding grounds.

Morgunbladid 71 (156), p. 60. Hunting for health purposes.

Morgunbladid 71 (166), p. 93. Leave the seals alone.

Morgunbladid 71 (187), p. 56. Around 2,000 seals caught.

Morgunbladid 71 (233), p. 22. News from Austur-Bardastrandarsysla county: seal hunting evaluated as special privilege of farms.

NT 68 (108), p. 24. The price of seal pelts is going up.

NT 68 (119), p. 36. Bad news for lump-fish fishermen in the Strandir area: the seals eat from their fishing nets.

NT 68 (168), p. 2. The sale of seal pelts is not going well: the Union of Icelandic Cooperatives a two-year supply in stock.

NT 68 (169), p. 2. Seal pelts: all the stock from last year has been sold.

NT 68 (221), p.7. Olafsvik (East Iceland): removing the nematodes is expensive.

NT 68 (250), p. 6. An open letter to The Minister of Fisheries.

Visir 66 (171), p. 3. The harbor seal population observed from the air;-nematodes can only multiply in seals.

Visir 68 (207), p. 8. The grey seals in the Orkneys.

Timinn 60 (137), p. 1. The seal eats 60-100 thousand tons of fish each year. An interview with Dr. Bjorn Dagbjartsson on the consumption of fish by seals.

Timinn 61 (271), p. 1. A number of grey seals now breed in the northernmost part of the Skagi area;-the invasion by the grey seals of North Iceland started five to six years ago.

Timinn 62 (230), p. 24. In the Orkneys the intention is to cut the grey seal population in half; -they are thought to eat 60 thousand tons of cod.

Timinn 62 (231), p. 1. There are 45-50 thousand seals around Iceland;-they eat around 100 thousand tons of fish each year.

Timinn 64 (215), p. 3. More severe action is needed in the fight against the seals, so that the nematode problem in cod can be decreased. This is a question that fish specialists and marine biologists are thinking about these days.

Timinn 66 (156), p. 20. The Scandinavian nature protection associations held a meeting in Stykkisholmur (West Iceland).

Timinn 66 (159), p. 3. More than seven hundred jaws have been submitted to the Nematode Committee. Still more are being kept by representatives of the Nematode Committee. The Association of Icelandic Animal Lovers files charges because of the seal killings.

Timinn 66 (171), pp. 8-9. The seal madness - by Bergsveinn Skulason.

Timinn 66 (172), pp. 6-7. Seal murder- by Helgi Hallgrimsson.

Timinn 66 (256), p. 4. The organization of the hunt will probably not change.

Timinn 67 (22), p. 7. Jon Jonsson, Director of the Marine Research Institute: Comments on the basis for consultation on fishing by the Marine Research Institute.

Timinn 67 (70), p. 9. Do the seals cause sizeable decrease in the salmon fisheries? -by Einar Hannesson.

Timinn 67 (80), pp. 1 & 3. Steingrimur Hermannsson, Minister of Fisheries, comments on the grading of fish: "the saltfish producers should not produce anything but top quality fish." "This is terrible news - we must improve inspection".

Timinn 67 (June 30th) p.32. Special travel edition. "Saemundur the Wise..." - An advertisement from Icelandic Air (picture of a seal).

Timinn 67 (278), p. 2. Are the nematodes to blame for the decreased speed of growth of individual cod?

Timinn 68 (12), p. 14. The sheriff of Vestur Hunavatnssysla county: "I am surprised that a bounty should be granted for seal hunting".

Timinn 68 (27) pp. 6-7. A paper by the Nature Protection Council (Natturuverndarrad) on nematodes and seals.

Timinn 68 (90), p. 9. Seal hunting should come under the jurisdiction of the Ministry of Fisheries.

Thjodviljinn 44 (34), pp. 5 & 18. Are the seals our competitors for harvested fish? The Marine Research Institute estimates the seal population around Iceland to be around 55 thousand animals.

Thjodviljinn 47 (201-2), p. 31. The state prosecutor dismissed the charges. The Nematode Committee is acting on full legal grounds.

Thjodviljinn 47 (89), p. 23. Nematodes in fish cause extra costs in the fish freezing plants.

Thjodviljinn 47 (139), p. 16. Is seal hunting a thing of the past? No markets for seal pelts.

Thjodviljinn 47 (157), p. 16. The Association of Animal Lovers considers action: will the Nematode Committee be charged?

Thjodviljinn 47 (158), p. 10. Nematodes in fish and the biology of the sea - Johann J.E. Kuld, on the fisheries.

Thjodviljinn 47 (160-161), p. 32. "Name of the week" -Bjorn Dagbjartsson.

Thjodviljinn 47 (166-167), p. 8. Jatvardur Jokull Juliusson: to catch a seal and kill it.

Thjodviljinn 47 (172-173), p. 32. The Ministry of Farming rejects the case. The case of the seals is still floating around in "the system".

Thjodviljinn 47 (175), p. 16. The seal killings around Iceland. The media were not to know anything: this is stated in the report that is the premise of the seal killings.

Thjodviljinn 47 (256), p. 3. The seal hunt this year is not half as large as it used to be.

Thjodviljinn 47 (258), p. 3. Stop the seal killings, disband the Nematode Committee, states the Icelandic Association for the Preservation of Nature.

Thjodviljinn 48 (19), p.16. Are actions being taken that increase the spread of nematodes?

Thjodviljinn 48 (53), p. 1. (Picture) Caught in the act.

Thjodviljinn 48 (74), p. 3. The Portuguese complain about nematodes in saltfish; 1200 tons of saltfish sent back; saltfish producers must in the future clean the fish free of worms.

Thjodviljinn 48 (128), p. 1. A seal on its way to church?

Thjodviljinn 48 (141), p. 20. The general meeting of the Agricultural Society of East Iceland: the seal breeding grounds are in danger. "They have gone very far" states Bjorn Dagbjartsson.

Thjodviljinn 48 (143), p. 24. Orn Thorleifsson, farmer on Husey Island, states that the intention was to encourage farmers to hunt seals.

Thjodviljinn 49 (32), p. 2. The nematode problem was discussed in The Icelandic Parliament yesterday. Is it the grey seals or the gulls that are guilty; or is the explanation less offshore and more inshore fishing?

Thjodviljinn 50 (8), p. 3. The Nematode Committee refuses to answer. Four biologists write to The Minister of Fisheries.

8.0 Appendix: Seals and seal hunting in Breidafjordur Bay

Written by Eysteinn G. Gislason, farmer, Skaleyjar Islands in Breidafjordur Bay, West Iceland, November, 1982.

I have been asked to express my opinion on the topic of the title of this section by two parties concerned with it. As I have experience of these matters and have also formed my own opinion on them, it is easy for me to express myself. I have also consulted others on the matter; in a meeting in the Kroksfjardarnes area, where "traditional seal hunters" had gathered, these matters were discussed, although time did not allow the writing of a statement of the meeting's conclusion. The following will mostly be my own views, while I have also taken the views of others into account.

As is commonly known, the Breidafjordur Bay area is in many aspects unique, and parts of it are documented in the Registry of Unique Nature Areas of Iceland (Natturuminjaskra). Research is to be done on its ecology and, if necessary, the area is to be protected. The area includes an ideal environment for the two main Icelandic seal species; they also have breeding grounds and living areas all over the inner parts of the bay. The seals have traditionally been a very important asset for farmers in the area; that is until a few years ago. Presently there is no demand for seal products. However, this situation could change.

Following the introduction of firearms, many felt that they would decrease the seal population, and that the seals would be in danger of extermination, especially in the southern parts of the bay. It is interesting to note how quickly it was realised that firearms were a danger if used on the seal breeding grounds. I will discuss this point later. A struggle started for the protection of seals against firearms in Breidafjordur Bay. It did not have immediate results; however, in the end the killing of seals with firearms was banned, within an imaginary line extending from Ondverdarnes peninsula to Bjargtangar cliffs. The inhabitants of Northern Snaefellsnes were, however, not content with this, as no seal breeding grounds exist in the outer parts of their area, and for many, the shooting of seals was an important source of income. They succeeded in having the protection line moved into the inner parts of the bay. From 1925 this line has been drawn from Eyrarfjall mountain to Stagley island and from there on to Bjargtangar cliffs. In the area that exists withing this line, law prohibits the shooting of seals; violations can be punished with fines.

There is no doubt that the law has protected the seal species in the area, even thought it was not always respected while seal products were in demand. After the meat from the seals was no longer in demand, the oil had dropped in price, and the same had happened to the pelts of mature animals, breaking this law probably stopped. Pups are not hunted with firearms; they are caught with nets in the spring, and clubbed, or other traditional methods used in the fall. Farmers have

practised hunting by these means on their own properties, without interruptions, as the price for seal pelts has been high. However, this has now changed because of foreign propaganda against seal hunting. As the market has been wiped out, the traditional pup hunt has decreased so severely that it is now only a fraction of what it used to be. It used to keep the population in balance, like the slaughter of lambs on sheep farms. If the hunt stops, the seal population will increase; unless it is replaced by something else. This has been a concern of fish processors. As can be expected, those still hunting seals can easily observe fluctuations in the size of the seal population in their areas. If the population is in balance, and if the seals do not migrate heavily between areas because of external interference, the numbers caught each year should be similar.

The harbor seal does not appear to be increasing at all, despite the great decline in the hunting of pups. At least in some areas, there even appear to be fewer pups on the breeding grounds than a few years ago. For example, here in the Skaleyjar islands, the annual catch of seal pups was around 100-130 pups, while in the last few years we have caught only 60-80. It should be noted that we have not hunted as extensively as before; while I, however, doubt that we would have caught more pups even if we had tried. The simple explanation of this decrease could be simply that many harbor seals, mostly pups, have been caught in lumpfish nets in the outer parts of the bay. Lumpfish fishing has increased in that area in the recent

years. This could be the sole explanation of fewer pups on the breeding grounds in the inner parts of the bay, and the total harbor seal population has possibly not gone down at all. However, nothing implies that it has increased. This would imply that it is unnecessary to take special actions to decrease the population.

The grey seal is a different case. Many things seem to imply that it has increased considerably. This was to be expected. Pelts from pups caught in the fall have for a long time received a low price, and consequently hunting pups in the fall declined sooner than the spring hunt. They also do not get caught as easily in lumpfish nets as the spring pups, as they are older and more cautious than the spring pups in the period when the lumpfish nets are laid. The possibility exists that measures to decrease the seal population are necessary. This would be the case if it is proven that the seals are no longer a useable animal but instead a pest that can cause damage.

I want to state the following about possible measures for decreasing the seal population in general: in the present situation it would not have much effect on the economy of farmers or of the nation as a whole, if the seals were completely exterminated. However, if they are allowed to live, they could possibly gain their former role as an important useful animal; proper hunting of them would guarantee a new balance, as existed before. On the other hand, the argument also exists that major killings of a wild mammal must be a great and difficult decision,; it must not be taken by any

other than responsible authorities, following careful consideration of the matter. Examples exist of actions of this nature having caused serious imbalances in nature, without solving in any way the problems they were meant to solve. It is possible that nematode infection of fish can be decreased by decreasing the seal population. However, opinions on this point differ. Has it been proven at all?

I must admit that I was concerned when I heard of the granting of bounties earlier this year. This action has so many obvious disadvantages that most people must agree with the serious criticism it has received. To begin with, a decision of this nature should not be left to just anyone; secondly, this action can result in something drastic. As an example, in the fall pups in some areas crowd together in the same place just above the sea, where the female seals take care of them. The pups are frequently heavy, so they can be heavy to drag down to the ocean after having been killed, sometimes through difficult terrain. If they can profit by it, irresponsible individuals will commit a major slaughter on these breeding grounds, leave the carcasses, and only pick up the jaws. It is easy to see the problems by such activity.

Here in Breidafjordur Bay, the bounty will encourage the breaking of the law. A much higher price is paid for killing mature seals than pups. Mature seals are rarely caught except with firearms. Various other arguments exist against encouraging the public to commit terrorist acts against nature,

but only a few points will be mentioned here in objection to the shooting of seals.

It has been mentioned that it is possible that the protection of seals in Breidafjordur Bay will be completely removed with the new law on seal hunting. I would consider this a ridiculous act; I submit a most serious warning against it. I speak for many who are familiar with the matter, when I state this. It appears odd that at the same time as research and protection is to be encouraged, uncontrolled shooting is to be allowed in this area.

It is obvious that if the shooting of seals is to be allowed, and a bounty also paid for killed animals, this will lead to mass slaughter, as the hunters can expect good profits. Not only the seal will feel the effect of this.

It would be much better, and probably the only logical solution, to place the shooting of seals in Iceland into the hands of hired hunters. If it is thought unavoidable, because of a decreased pup hunt, to lower the seal population around Iceland, this should be easy to do under the direct control of the authorities. The decision would never be made to hold the Icelandic reindeer stock in balance by granting a bounty for the shooting of those animals.

The shooting of seals is probably even worse than the shooting of reindeer, as inexperienced hunters only catch a part of the animals compared with the numbers they wound and kill. In former times poor Icelanders received very important

benefits from the shooting of seals, while this argument rarely applies nowadays.

I feel that it is possibly correct that shooting by clumsy and inexperienced hunters destroys breeding grounds, scares the animals away, and results in wounded seals and sunk carcasses. The people who formerly fought for the protection of Breidafjordur Bay knew this.

It is possibly all right to pay a farmer for hunting pups, if the market can not pay a decent price for them. However, we must be ensure that this will not lead to adventurism and poor hunting methods.

If possible, the use of natural resources should always be encouraged, but leaving the carcasses in the open should be banned.

My main points can be summarized in the following manner:

1. It is unjustifiable that any "Tom, Dick or Harry" can decide to attack a wild mammal species anytime he wants or grants a bounty for its killing without ensuring proper hunting methods.
2. Decisions to decrease the seal population should be taken by legal authorities; they should be based on clear proof that the action will lead to benefits. Actions based on speculations are not justifiable.
3. Decreases in the seal population should be left to experienced people, while others should not take part in such actions.
4. Farmers should be supported in hunting pups, while the market does not do this. This support should be limited to

those owning farms, so that other individuals can not go to the seal breeding grounds and commit unjustifiable acts.

5. While they can not be exported, the local use of seal products should be encouraged; for example the fat (oil) for mixing with other feed which will go to fox and mink farms, and seal pelts for the Icelandic production of various goods (bags, souvenirs etc.).

6. The harbor seal does not appear to be increasing, while this appears to be the case with the grey seal population.

7. Everyone that I am familiar with who knows anything about the matter, thinks that it would be nonsense to lift the ban on shooting seals in the inner parts of Breidafjordur Bay. The authorities should be able to take the action they desire for decreasing the number of seals without lifting the ban.

ABOUT THE AUTHORS

SIGRUN HELGADOTTIR studied biology at the University of Iceland and continued her education at the University of Edinburg. She finished her Masters in resource utilization in 1981. Sigrun Helgadottir is currently working for the Nature Preservation Council. She sat on the board of the Icelandic Society for Nature Conservation in 1981-1983.

STEFAN BERGMANN studied biology at the University of Belgrad and did his graduate work in ecology at the same university. He is currently associate professor at the Icelandic Teachers Training College in Reykjavik. He sat on the board of the Icelandic Society for Nature Conservation from 1973 to 1981.

AEVAR PETERSEN studied zoology at St. Andrews University in Aberdeen and finished a Ph.D at Oxford in 1981. He has been the manager of the zoology division of the Icelandic Museum of Natural History since 1978 and director of the museum since 1983.